ENGINEERING NEWS.

ANOTHER tunnel under the Alps is just now again being vigorously discussed in Switzerland. The choice lies between the Simplon, Mont Blanc and Mont St. Bernard. From Paris to Milan it is about 656 miles by the St. Gothard tunnel; and by Mont Blanc would be 683 miles; by the St. Bernard 639 miles, and by the Simplon only 583 miles. The main advantages advanced by the advocates of the several routes are as follows:—There would be less water to deal with at Mont Blanc; the Simplon tunnel would be shorter and cost less by $1,000,000 than the other two, and in the St. Bernard the rock is comparatively soft. French engineers and business men prefer the Simplon as commercially the best for them; although such a tunnel would increase the commercial interests of Genoa at the expense of Marseilles. The Simplon tunnel would be about 12¼ miles long, and it has the advantage of already possessing lines of access. The cost of a single-track line is estimated at $10,600,000; and for double-track, at $12,600,000. It is believed it could be finished in six years.

WORK on the tunnel under the St. Clair river, at Port Huron, which is being built by an independent corporation, but in the interest of the railroads connecting at that point, is being pushed rapidly, yet it is still doubtful if the project will be carried through. It will be cut through a strong clay overlying the rock which is about 90 ft. below the surface of the water. The length will be one mile; 2,310 ft. under the river, 1,160 ft. under dry ground on the Canadian side, and 1,810 ft. on the American side. The gradient at the ends will be one in fifty. The open cutting on the east end will be 3,270 ft., and 2,820 ft. at the west end. The lowest part of the tunnel will be 80¼ ft. below the surface of the water. The cross section will be circular with a diameter of 20 ft. A trial heading only is now being driven for the purpose of testing the material, but shafts at each end have been sunk to the bottom line of the tunnel without meeting with any difficulty.

THE failure of the foundations of the capitol at Albany has again been made the subject of an engineering investigation, this time by Mr. W. H. SLINGERLAND, who reports as follows: The cracking of walls is due to inequality in the settlement of the various parts of the building. At the northwest corner, the settlement from the bench-marks of 1882 is 0.079 ft.; from this point eastward it gradually decreases until at the Washington avenue entrance, it is only 0.013 ft.; at the northeast corner it is 0.071 ft.; at the southeast corner, 0.179 ft., and 28 ft. south of this last, it is 0.198 ft., the maximum sinking on the exterior. At the southwest corner it is 0.079 ft., with a slightly irregular line between this point and the last named. In the interior, depressions below the same bench-marks are found of .041, .164, .150, .038, etc. The deflection outward of walls and piers has increased since 1881, to the extent of half an inch in the north wall of the central court. As to the stone ceiling of the Assembly room, which is now causing considerable apprehension, new cracks have appeared. The sandstone used in the construction of this ceiling is condemned as unfit material for the stresses put upon it; repair has so far failed and the report recommends its removal as the only safe course to pursue.

STEEL railway ties were introduced into Mexico in 1884 on the Vera Cruz line, and 20,000 are there now in use. That they have been satisfactory is proved by the late order of 40,000 more from England. Steel ties cost, delivered in Mexico, about $2.08 each; while wooden ties cost from $0.93 to $1.66, according to the character of the wood.

THE London Metropolitan Board of Works, with taste and good judgment unusual to similar bodies, has forbidden the erection of the proposed 420 ft. high brick "Victoria Jubilee Tower" in that city. The reasons given for this unexpected action were, that the proposed tower was a monstrosity in design and that it was a very undesirable edifice in the locality proposed (*i. e.* at Spring Gardens) and one calculated to interfere with the architectural effect of Trafalgar Square. Considerations of this kind in dealing with a purely money-making scheme even if the instrument were less ornamental than a factory chimney, would be novel coming from the average city officials of our own land.

A BILL is now before the Legislature of Connecticut requiring every railroad company which pays over 10 per cent. dividends to take out their highway grade crossings. The bill would require the New York, New Haven & Hartford, which shows net earnings of nearly 14 per cent. over and above interest and taxes, and a surplus for the year, after paying 10 per cent. dividends, of very nearly $600,000 to expend $310,000, the Naugatuck company $40,000, and the Stonington company $16,000 per annum in discontinuing their grade crossings, and these amounts would pay the total cost of abolishing 77 crossings per annum of the New York road, 10 on the Naugatuck, and 4 on the Stonington road; and would enable the first named company to wipe out its 205 crossings within three years.

Only the three companies mentioned pay the specified dividends, and the legislation proposed is certainly not unreasonable, since a large expense would be saved to the companies nearly equal to the interest on the cost of the work, if not quite.

THE reported destruction of a valuable collection of maps relating the geography of the Soudan by Major MANTELL, of the British army, is a most unaccountable and colossal piece of stupidity. To "clean up" the map-room in the Citadel at Cairo he is said to have destroyed about all of the maps, plans and military achives relating to the Upper Nile and great lakes and from the Red Sea to El Obied and El Fasher, a region now practically inaccessible.

A TEST was made on Monday of last week of a train composed exclusively of cars closely coupled, allowing practically no slack, which left Burlington on the Chicago, Burlington & Quincy road, and was taken through to Pacific junction. The result has practically settled the heretofore controverted question whether slack in a train was necessary, by indicating that a train can be easily started and handled when the slack is taken out if it is properly and carefully handled. This question was practically settled at a test made at Burlington at the conclusion of the brake tests last summer, by indicating that slack was of slight importance for starting trains, while it had a very injurious effect upon the smoothness of motion. This test tends to confirm this conclusion, and practically assures that when a close coupler is adopted for use throughout the United States, it will be of the close coupling or hook type.

THE Sukkur bridge, to be built over the Indus, at the town of that name in India, will have but one span of 820 ft., composed of two cantilevers each 310 ft. long, and a center latticed girder of 200 ft. The bridge will be single track for the 5 ft. 6 in. Indian gauge. This bridge was designed by A. M. RENDLE, and the ironwork is being built by BAILLEY, WESTWOOD & CO., of Poplar, England. When completed, this cantilever bridge, it is claimed, will rank second to the Forth bridge for length of span. But the proposed Blackwell Island bridge over the East River will be very close to it with 810 ft. betweens faces of towers, and exceed it if the Sukkur bridge span is given from centers of towers, as may be the case.

Mr. A. MANNE, Gen. Manager of the St. Paul, Minneapolis & Manitoba Railway, writes us contradicting the statement that they are expecting to use an electric light plant as an aid to track-laying, stating "we do not expect to have any use for electric lights, considering that the daylight in that section will be ample for our purpose." Thus it would appear that this latest technical sensation, which was described in much detail, was manufactured out of the whole cloth.

AT Montreal the ice obstructions in the river are being blown up by dualin; the Dominion Government having appropriated $2,000 for the experiment. Holes were bored 100 ft. apart from Pointe aux Trembles to St. Helen's island; these holes were charged with dualin cartridges and blasted, the explosive having a shattering effect on the ice. It thought that when the spring thaw comes the shattered ice will readily escape.

THE investigation of the Bussey bridge disaster is still dragging its slow length along, chiefly by adjournment. Since our last issue two experts have been examined, Mr. GEORGE L. VOSE, late professor at Bowdoin College and the Massachusetts Institute of Technology, and Mr. HENRY MANLEY, M. Am. Soc. C. E., assistant city engineer. As we go to press on Friday, April 1, the eleventh day of the investigation and the eighteenth day since the catastrophe, Prof. CHARLES F. SWAIN, of the Massachusetts Institute of Technology, Mr. E. S. PHILBRICK, the experts employed by the railroad, and Mr. THOMAS DOANE, the expert employed by the Commission, should be giving their testimony, according to the announced programme.

THE proceedings are now very inadequately reported. Even the Boston papers have grown tired of reporting or even abstracting them in full, and the press of the remainder of the country gives only an inch or two of space, or even, with some of the New York papers, none at all. The practical effect is, that the testimony as to the derailment theories, and other matter which came first, was spread in full before the public, while the testimony which brings out the real facts—or part of them—is not given in any one paper so that it can be intelligibly followed, and it is only by piecing the various reports together that an intelligible idea of it can be obtained. We have briefly summarized a few salient points of the testimony elsewhere.

The expert testimony to date, in so far as definite opinions are expressed at all, conforms exactly to the opinions expressed by this journal on the second day after the accident, as was inevitable. The case is so entirely clear that no other result was reasonably possible, and it is risking little to surmise that the same will be true of the expert testimony which remains to be brought out. Nevertheless, the expert testimony so far given presents some very remarkable features, in respect to what it does not say, rather than in what it does say, on which we refrain from detailed comment until the further expert testimony is in, which we earnestly hope will be so clear and adequate as to lead to a finding which will make further comment than endorsement and approval unnecessary. With all respect to the gentlemen who have so far testified this is far from being the case now.

ACCORDING to the *Missouri Republican*, probably the fastest time ever made on a western railroad was accomplished recently by the "fast mail," which had been delayed over five hours by a small wreck on the Pan Handle line, and when Columbus, O., was reached, preparations were made for a special run to St. Louis. The run to Indianapolis was made at a high speed, there a fresh locomotive was attached, and the train pulled out at 1.21 A. M.; twelve minutes were consumed by stops at Greencastle, Terre Haute (where the engine was again changed) and Effingham, and the train reached East St. Louis at 6.21 A. M. The distance of 238 miles was made in 4 hours 16 minutes, including 16 additional stops, but deducting the long stops at the places named, the average speed was about 47.50 miles per hour. The fastest time was made between Highland and Collinsville, 18.7 miles; this was run in 16 minutes, a speed of 70 miles per hour.

A PLAN proposed for transporting natural gas long distances substitutes for the forcing process, an exhaust at low pressure and in large mains. Fans would be located 10 to 40 miles apart according to the undulations of the line. These would be about 16 ft. in diameter, and be boxed into the conduit; a 20 horse-power engine would drive this fan at about 30 to 50 revolutions per minute. The pipes would be sheet-iron and 5 ft. in diameter. A siphon is also proposed in which two lines of pipe would be used; in ascending a hill the lower pipe would be provided with burners to heat and rarify the gas; and after the summit was passed an upper pipe would discharge a spray of water over the gas mains and thus condense the gas. The risk of explosion and scarcity of water on hill-tops would probably interfere with the carrying out of this latter scheme.

The Lowthorp Trussed Wrought-Iron Turn-Table.

See Page 215.

The accompanying illustrations practically explain themselves. These turn-tables are built after the patent of F. C. LOWTHORP, by F. JORDON, of 200 Broadway, New York City. The chief feature of the design is to so combine the iron used as to best resist the strains to which it is to be subjected, and to do this in the simplest and most economical manner.

While the pivot-center is not new, having been tested by years of use, the illustrations show its latest application in practice. This pivot is the feature for which especially advantages are claimed as follows:—That by its use the balancing point is much nearer the center of gravity of the object to be turned than when balls or conical rollers are used; the bearing surface is more ample, and therefore, less liable to be crushed or cut, and the lubrication is more perfect, and finally this construction decreases the cost of production.

These turn-tables range from 21¼ to 55 ft. in length, and will safely bear a distributed load of from 20 to 70 tons. In their older cast-iron form they have been used on thirty or more railroads of this country, including some of the most important lines, and the general testimony is most decidedly in their favor, both as to efficiency in service and exceedingly slight cost of maintenance.

The following general table of dimensions is of interest in this connection:—

GENERAL DIMENSIONS.

	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft In.
Diameter of table, center of track	55	52	50	48	46	24 3	21 6
" " pit	55 2	52 2	50 2	48 2	46 2	24 5	21 8
" " circular track (rail center)	51 0	48 0	46 0	44 0	42 0	21 6	19 8
Height, under side of rail to top of girder	5½	5½	5½	5½	5½	5	5
" top of center stone to bottom of girder	4 3	4 0	4 0	4 0	3 10	3 0	1 10
" top of circular track to under side of rail	1 9	1 9	1 9	1 9	1 9	1 8½	1 4
Depth of girder at center	4 0	3 9	3 9	3 9	3 7	2 4	1 7
Size of center stone	4 ft. sq. 16 to 18 in thick.	4 ft. sq. 16 to 18 in thick.	4 ft. sq. 15 to 17 in thick.	3½ ft. sq. 15 in. thick.	3½ ft. sq. 14 in. thick.	3½ ft. sq. 14 in. thick.	2½ ft. sq. 12 in. thick.

The Car Stoves at Forest Hill.

The little cut we give, which is a fragment taken out from one of the larger photographs, tells its own story without much further help as to the degree of safety which the car-stove grants. All that needs to be added to it is that the official report of the Boston fire department shows that there were really three small fires which had started from as many points, and were put out in their incipiency. How one of them was put out has been well told by one of the witnesses, whose testimony is otherwise interesting:

C. A. FARRINGTON said: "I was sitting in the rear seat of the third car; the first thing I noticed was the derailment of the front end of the car; this was one-third of the way across the bridge; in less than six seconds the rear end of the car seemed to sink and the heads of the passengers in front appeared at least 6 ft. higher than our own. Then came a violent shock that tore away the flooring. The front platform of the car was carried forward and struck the abutment. The rear end of the car also struck the abutment with great force. I don't think we were going any faster than usual that morning. During the fall the car was blacker than I ever saw anything before. The first thing I saw when I got out was Conductor Tilden, who lay unconscious and dying. Then I saw Conductor Alden in the third car straightening up the stove which had set fire to the woodwork. He said to me: 'Get some water to put out the blaze with, that's a good fellow?' I hastened to the ditch with a bucket and poured the water on the fire, which had burnt a place about 4 ft. square.

It was fortunate indeed that a ditch was so near at hand, as likewise the fire department.

A fact that will strike most people as strange, is that this train should have been heated by only a single stove in the center of the car instead of by two stoves, one at each end; a barbarous way of heating which we imagined had practically passed out of use, especially in cold latitudes.

The Car Stove at Forest Hill.

Tunneling in Colorado.

A report of the Golden River Mining Co., of Placer Co., Colorado, gives the following detailed cost of a tunnel about 3,000 ft. long and 7 x 8 ft. section, through alternate strata of slate with iron pyrites, diorite and masses of white barren quartz; the direction of the tunnel was diagonal to the strike of the rock. Commencing work on July 2, 1886, 108 ft. was run by hand with an average force of six men; on Aug. 5 the air-compressor and drills were started, and on Jan. 31, 1887, the tunnel had reached a length of 1,552 ft. The last 1,444 ft. were run with an average force of 20½ men per day. During the seven months the compressor was idle for 15½ days on account of a cracked casting reducing the time to 6½ months work on the 1,552 ft., or an average of 234.1 ft. per month, including handwork. The two greatest runs made for two consecutive weeks were 71 and 84 ft. for six days work, or 11.82 and 12 ft. per day.

The full gang of men employed was as follows: 15 miners (8 hours per day each), 2 engineers (12 hours), 2 drivers (12 hours), 2 blacksmiths (10 hours), 1 timberman (10 hours). These were divided into three shifts and worked two Ingersoll "eclipse" drills on columns. The actual cost of running 1,552 ft. of 7 x 8 ft. tunnel, exclusive of management, was as follows:—

	COST PER LIN. FT
Totalpay roll, including 100 ft. timbering	$ 7.36
Powder; 10,567 lbs., Giant No. 2 at 26½ and 41½ cts.	1.70
Fuse; 39,650 ft. at $5.50; caps, $45	0.17
Wood; 402 cords, at $2.75	0.71
Charcoal; 1,604 bushels, at 20 cts	0.21
Candles; 1,760 lbs., at 16⅔ cts	0.19
Planks and ties; 7,385 ft. B. M., $20 at mill	0.09
Timbers; 43 sets, at 60 cts. per lin. ft	0 03
Steel rail; 16,640 lbs. at $60 per ton	0.33
Air and water pipes; 3 and 1 in., at 18 and 5½ cts. per ft	0.35
Horse-feed	0.18
Steel, oil, tools etc	0.45
Freight: at $1.25 per 100 lbs.	0.64
Total cost, $192,389.85, or per lin. ft.	$12.40

The above form has been adopted from the Big Bend Tunnel, and corresponds closely with the Sutro Tunnel forms.

The following form of one of the weekly reports shows the care with which Mr. CHAS. F. HOFFMANN, the superintendent, conducted the work:

RED POINT, Nov. 27, 1886.

REPORT FOR WEEK ENDING NOV. 2, 1886.

Total number of holes drilled	238
" " " reblasted	35
Total depth of holes drilled	1,216 ft.
Average depth of holes drilled	5.1 ft.
Number of pounds of No. 2 powder used	600 lbs.
Number of drills sharpened	250
Time occupied in drilling (by twenty shifts) 40 hours	25 min.
Average time per shift, two hours	01 min.
Number of carloads of rock extracted	392
Tunnel advanced per week	63 ft.
Previously reported	996 ft.
Total tunnel built to date	1,059 ft.
Number of working days	7
Number of shifts	21
Average progress per shift	3
Average progress per day	9
Number of carloads per shift	18.69

Twenty rounds of holes blasted; rock, hard slate, with cubes of iron pyrites.

Experiments on the Fluctuations of Moisture in Wood during Seasoning.

From experiments made for the Chicago, Burlington & Quincy Railroad Co. we obtain the following notes on the above subject, and deem them of considerable interest to those using lumber for structural purposes.

The experiments commenced Dec. 1, 1885, and ended Feb. 28, 1887, a period of one year and five weeks; the tests were made every alternate Monday morning. The purpose of these tests was to observe the variation in moisture of different kinds of wood (as indicators of seasoning), to learn the months during which the greatest amount of seasoning takes place, and finally whether wood when seasoned will take back its original moisture during the wet seasons of fall and winter as claimed.

For these experiments three pieces of rough dressed Norway pine, oak and ash, as green as could be obtained, were piled loosely one above the other with cleats between and a board on top so placed as to keep off drip and direct rain, but expose them to sun, rain and snow on the sides; the idea being to subject them to the conditions of the usual out-door seasoning of lumber. The center dimensions of these pieces was originally as follows:

Pine, 9¼ × 5¼ in., 14 ft. 2 in. long.
Oak, 8¾ × 5¼ in., 9 ft. 6 in. "
Ash, 8¾ × 4½ in., 8 ft. 5 in. "

For the pine tests, 5¼ in. was sawed off the same end each time, and borings taken from the center of the sawed-off block. From the ash, 4 in. were cut off for each of the first eleven tests, and 3 in. for the succeeding thirteen tests. From the oak, 5 in. were used for the first eleven tests, and 3 in. for the remainder.

The exact percentages of moisture obtained, are shown in the following table:—

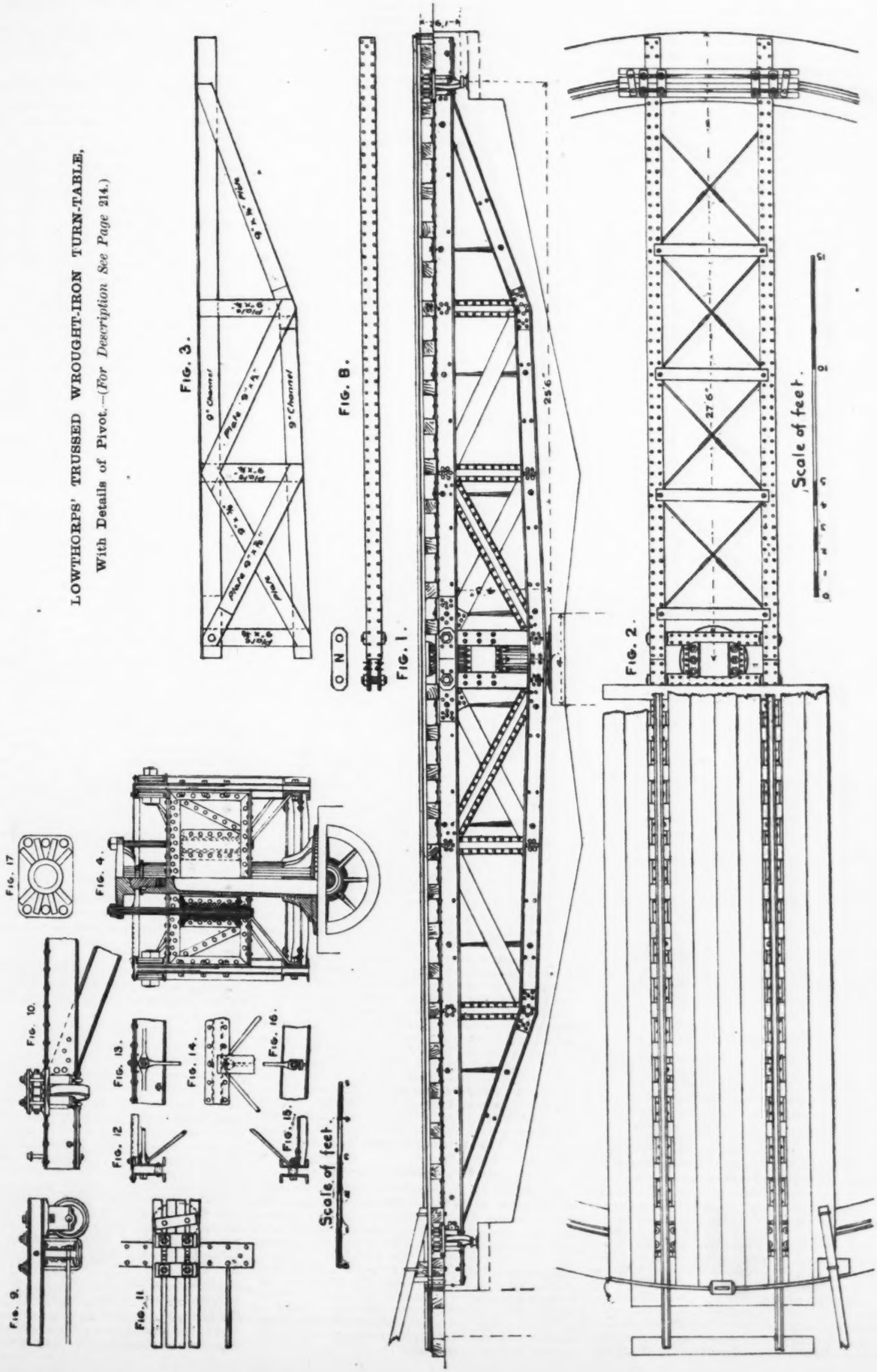
DATE.		PERCENTAGE OF MOISTURE.		
		Oak.	Ash.	Pine.
1885,	Dec. 21	40.93	27.56	24.25
1886,	Jan. 4	40.93	27.36	23.35
"	" 18	41.01	28.27	23.53
"	Feb. 1	42.36	28.31	23.84
"	" 15	42.63	28.98	23.88
"	March 1	42.14	28.87	23.25
"	" 15	42.53	28.25	23.12
"	" 29	42.03	27.25	22.62
"	April 12	42.25	26.66	22.44
"	" 26	41.23	24.68	21.63
"	May 10	39.45	22.98	20.83
"	" 24	37.29	22.79	19.40
"	June 7	37.05	20.78	17.81
"	" 21	36.79	20.58	18.14
"	July 6	35.70	17.78	16.14
"	" 19	36.77	15.84	15.74
"	Aug. 2	34.99	12.74	12.65
"	" 16	35.91	13.84	14.02
"	" 30	35.03	14.06	14.04
"	Sept. 13	34.65	13.26	13.33
"	" 27	36.66	13.00	15.36
"	Oct. 11	33.54	12.02	13.48
"	" 25	33.50	13.77	14.28
"	Nov. 8	33.33	14.02	14.41
"	" 22	(Stolen).	13.78	14.68
"	Dec. 6	.....	.....	14.55
"	" 20	.....	.....	14.92
1887,	Jan. 4	.....	.....	14.49
"	" 17	.....	.....	14.10
"	" 31	.....	.....	14.61
"	Feb. 14	.....	.....	14.35
"	" 28	.....	.....	14.61

The experimenter, in commenting on this table regards the fluctuations of moisture in the three specimens as unimportant from Dec. 21, 1885, to Feb. 15, 1886. The seasoning, or loss of moisture, practically began on the last date and ended Aug. 2, with the ash and pine, but apparently on Oct. 11, with the oak; the latter test, however, was not quite satisfactory. The experiments are being continued.

While wishing to avoid the common error of generalizing from insufficient data, the experimenter believes he is justified in the following conclusions:

LOWTHORPS' TRUSSED WROUGHT-IRON TURN-TABLE,

With Details of Pivot.—(*For Description See Page 214.*)



1. That with oak, ash and pine woods in a green condition seasoning begins very early in spring (modified by the weather) and ends in mid-summer; viz., during the months of March to July inclusive. 2. For the woods mentioned, after once being seasoned they will not take back their moisture beyond slight amounts in wet and cold seasons. These conclusions are true only for the inner part of the wood of the dimensions given. Other conditions of kind of wood, time of cutting, treatment before test and size of pieces may alter these conclusions somewhat, but it is believed not materially so.

Steel Chains Made Without Welds.

The Engineer describes a process of manufacturing steel chains without welding which is sufficiently interesting to be reproduced as follows:—

A new process for the manufacture of chains without welding was invented some little time ago by M. OURY, chief of the Maintenance Department of the Marine at Cherbourg. After various trials in the arsenal, a factory

Fig. 1.

has been built at Massaelière, near Terre-Noire. The inventor being dead, the French patent has been taken up by a company. The OURY system consists in cutting the chain links into a bar of metal cast and rolled in form of a cross with equal arms. The metal employed has 0.178 per cent. of carbon, and 0.452 per cent. of manganese; its tensile strength is 47 kilogs. per millimetre, (61,158 lbs. per sq. in.) and its elongation is 10 per cent. to a length of 200 mm. The metal will not temper. The bars employed are about 23 ft. long, and

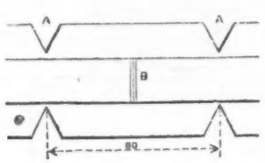


Fig. 2.

have a transverse section, the form and half size of which, for a chain of 18 mm., (0.7 in.) are shown in the sketch, Fig. 1. This steel weighs about 15 kilogs. per metre run, or about 10 lbs. per lin. ft.

The company is supplied with the bars ready rolled, from the forges of Terre-Noire. We have only therefore, to consider the various transformations through which the bar passes. The first operation is performed hot, with a double cutter. The cutter is placed at the door, and operates on the bar as it is withdrawn

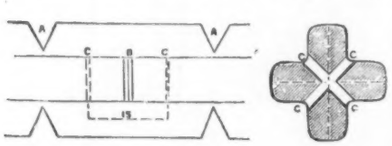


Fig. 3.

from the furnace; it passes between two tools which act at the same time, the one descending, the other rising, and producing the notches *A*, Fig. 2.

The notches are 90 mm. (3.54 in) from one another from center to center, and the distance between them is regulated with exactitude by the machine. When the notches are completed over the whole length of one arm of the cross, it is re-heated and passed under the cutter, which acts on the second arm, and produces the notches *B* exactly midway between the cavities *A*. The second operation is performed without heat. A workman marks the place where the oblique incisions are to be pierced; these incisions are 45 mm. (1.77 in.) apart. The boring is done by means of small vertical machines and American twist drills, worked by boys; the drills are 7 mm. (0.275 in.) in diameter and 35 mm. (1.375 in.) in length. The space between the incisions being 45 mm. (1.77 in.) a bar would contain $\frac{7000}{45} = 155$ links; the loss at the two ends, however, reduces them to 152 or 153. The third operation is done hot with a double mortice cutter, furnished with curved punches. Each branch of these curved punches has a section straight on the inside, and of a long-shaped semi-ellipsis on the outside. The punches produce the shaded cavities *D* in the bars; their length is the same as that of the spaces between the oblique incisions *C*. Fig. 4. The distance between the two branches of each punch

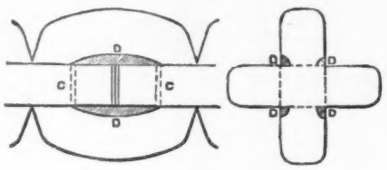


Fig. 4.

is a little less than the thickness of the arm of the cross; these tools raise by the fraction of a millimetre the arm placed vertically under the instrument before hollowing out the cavities D. Only a little less than a quarter of the depth of the bar is hollowed out by first punching.

The fourth operation deepens and enlarges the cavities *D*, and gives an oval form to the links by

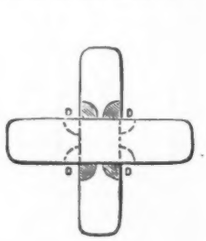


Fig. 5.

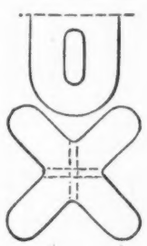


Fig. 6.

wedging back the metal. This operation is similar to the preceeding one, the punches only being replaced by larger ones. After the second punching only a line of space remains between the two cavities—Fig. 5. The fifth operation is done hot with a swage or die, its object is to give by stamping and transfer, form to the links. Every bar is heated and passed twice under the swage. The cavities *D*, have now been deepened, and

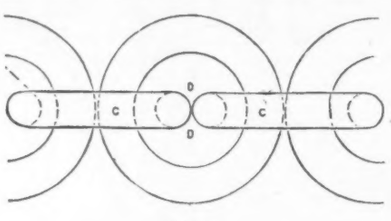


Fig. 7.

only a thin fin of metal remains. For the sixth operation no heat is required: it is done by two workmen, whose business it is to drive out the thin fin *D*, with a hammer, to cut off the exterior and interior of the rings, then with a pointed chisel to break the adherent parts of the links by a blow. The rupture takes place at the part weakened by the nick *C*. The links thus detached, the chain is in form, Fig. 7.

The seventh operation is done hot. It consists of shaping the detached links by a stamp of 550 kilogs. (1210 lbs.). The four last operations all relate to finishing and perfecting the work. A link of weldable steel is used for joining the ends of the chains to each bar. This weldable steel has a tensile strength of 50 kilogs. to 55 kilogs. per sq. millimeter (71,115 to 78,226 lbs. per sq. in.) and its elongation is 20 per cent to 24 per cent.

The following figures will show the results of experiments:—Four pieces of chain of three links of 18 mm. (0.7 in.) presenting a double section of 510 mm. (0.78 sq. in.) have been submitted to a strain of 15,700, 22,300, 21,200 and 20,700 kilogs., being 30.8, 43.7, 41.6 and 40.5 kilogs. per sq. millimeter (43,807, 62,154, 59,168 and 57,603 lbs. per sq. in.). The two first were broken, and the two last were found equal to the test.

Beacon Hill Tunnel.—The West End Street Railroad Co., at Boston, HENRY M. WHITNEY, President, has asked the Legislature for authority to build a tunnel or tunnels under Beacon hill and the common; the city end to be at a point near Tremont and Park streets, where there will be a large depot. The scheme is to furnish better street railroad facilities for Boston, Cambridge, Somerville, Newton, Chelsea and Brookline, and the petition asks for the confirmation of the consolidation of the Boston Consolidated Street Railroad Co., and of the union of the Charles River Street Railroad Co., and the Cambridge Railroad Co. The company proposes to operate its lines by electricity.

The New Thames Tunnel.

The *Pall Mall Gazette* describes the New Thames Tunnel, between the Monument and the Elephant and Castle. We abstract as follows:

This subway, now under construction, lies about 45 ft. below the London roadways and 15 ft. below the bed of the Thames. Two independent tunnels, each 10 ft. in diameter, will start from a point near the Monument and pass under Swan lane; as this thoroughfare is very narrow, the tunnels lie one over the other, with 5 ft. of earth between, so as not to encroach on adjoining property. As they pass out to the river, the bottom tunnel gradually rises until the two finally run side by side with 5 ft. of earth still between them.

Work is now carried on from a shaft, at Swan Pier, which shaft is 13 ft. in diameter and 60 ft. deep to the first tunnel and 75 ft. deep to the second. The tunnel runs through the tough London clay and is driven after the following manner: A small heading is first driven into the clay and timbered; then a distance of 18 in. is roughly shaped out with pick and shovel to the full diameter of the tunnel, and the "shield" begins its work. This shield, as near as it can be made out from the *Gazette*, is in the form of a cap embracing and extending back over the end of the 10 ft. cylinder, and is provided with steel cutters on the outer circumference, and is pushed forward by hydraulic pressure 18 in. at a time; it prevents any caving of material while the tunnel plates are being put in place and bolted, and the space outside the tunnel shell, represented by the thickness of the shield, is afterwards filled by injected cement grout.

The tunnel-shell is made of cast-iron "which will not corrode;" and is put in in segments 18 in. wide and 1 in. thick, with six segments and a key-piece to complete the circle. These segments are joined to each other by inside flanges bolted. The average advance made was 10 ft. per day, and the Thames was thus tunneled in sixteen weeks. The entire length from end to end will be 1⅛ miles and the ultimate cost £300,000, or about $1,000,000, per mile.

Hydraulic lifts will be used to handle the passengers (it is intended for foot traffic only) at the three stations on the line. This traffic will be conducted through the tunnel by trains of three or four carriages propelled by an endless cable, each train to convey about 100 passengers. They will run at two or three minute intervals and cover the distance in about six minutes. One penny (2 cts.) will be the fare for the present length. When extended to Stockwell, as proposed, the tunnel will be three miles long; 1,500,000 passengers per mile per annum, are figured as being necessary to pay working expenses and 5 per cent. on the capital invested. This number of passengers should not be difficult to obtain as the Metropolitan Railway now carries 3,250,000 per mile.

The Shrinkage of Clayey Soils.

BY M. THANNEUB, Eng. *Ponts et Chausses.*

Translated by H. N. OGDEN.

The contraction or shrinkage of clayey soils has caused trouble to those who have made their calculations without taking this feature into consideration.

In the embankments built in 1874—1882 from the quarry-clay and green loam of the Coulomnieer district an allowance of 10 to 15 per cent. was made as compared with the excavation. But in spite of this precaution these embankments settled. Capt. MARTIN, of the English engineers, showed in a paper, read March 23, 1882, that for certain miry loams the shrinkage attained 23½ per cent. Preliminary test can alone determine the co-efficient for any particular case; but prudence will indicate 25 per cent. as a minimum allowance.

Capt. MARTIN says further:—"The contraction of clay used in moulding, either from drying or from the application of heat, is well known; brick-makers and potters take it into account, but builders of earth-works seem usually to consider that the waste in transfer from cut to fill will vitiate calculations, and further that the shrinkage, by cracks and clefts, will compensate for the other characteristics of the filling."

That this is sometimes a mistake is shown by the experience in building the "new wall" at Calais.

Here on the south front the ditch was dug in miry loam, and the difference in volume, between the excavation and material extracted, was so great as to be at first charged to error in calculation. Re-examination divided the cuts and fills into two distinct groups as follows:

	Total Excava.	*Total Fill.*	*Waste.*
East of the canal	72,536 cu. yds.	65,568 cu. yds.	23.5 %
West of the canal	92,632 "	72,398 "	22.6 %

The difference of 1.5 per cent. between the two is explained by the presence in the second cutting of a vein of gravel, which could not be accurately calculated, but was estimated at about 13,000 cu. yds. Taking this gravel into account, the average of the waste is about restored.

To still further illustrate this shrinkage question experiments have been made as follows: An excavation was made specially of 5,174 cu. yds.; the earth removed was levelled and tamped on a heavy timber platform, and when measured was found to contain 4,918 cu. yds. This dirt, however, was artificially moistened to compensate for drying; and as the water already in the soil could not be measured, it was impossible to arrive at relative quantities of moisture. As a certain portion of this water drained off from the "filling," it is reasonable to conclude that the first settling, to the extent of about 5 per cent., is explained by this loss of moisture. In the experiment above noted a cube (0.45 cu. ft.) weighing 50 lbs., was taken from the levelled and pounded and still fresh earth; this cube kept for some days at the normal temperature dried quite rapidly, and after one year was reduced to a volume of 0.39 cu. ft. and weight of 45.5 lbs.

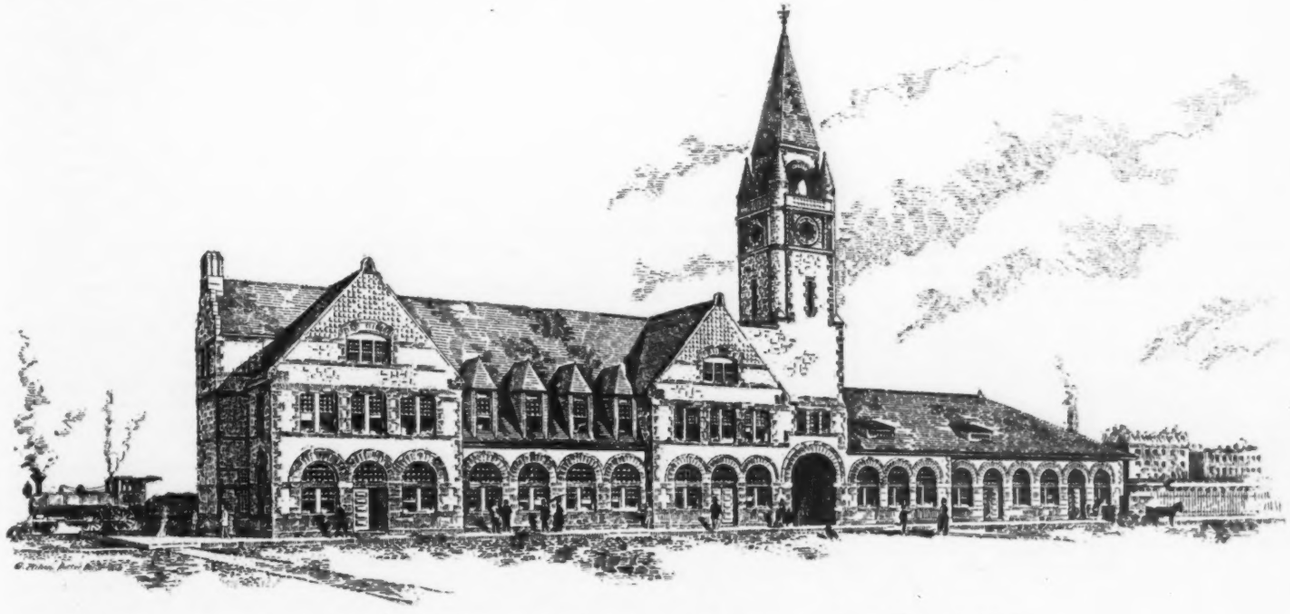
According to this sample test muddy earth of a volume of 0.95 cu. yds., at time of excavation, would be reduced to 0.804 cu. yds. at the end of one year. While this experiment was on a small scale and would and only indicate a loss of 20 per cent., it must be noted that the excavation was only 3.28 ft. deep and the fill 2.33 ft. high; moreover the shapes were not truly geometrical, so that an error of at least 1.5 per cent. is very possible. It might be added, however, that this filling, from the conditions, could not sink into the ground.

The Engineer, in criticising the criticism of a professor of physics on the charged misuse of technical terms by civil engineers, thus "picks up" the professor: "Here it is:—'This shows how deep a root has been taken by the extravagant laudations of MAYER, which were so common twenty years ago, but which have long since been thoroughly exploded.' Laudations which can take root and then be thoroughly exploded are not things to be spoken of lightly, we take it. They may be relegated to the company of the birds of the air which, according to Sir BOYLE ROACH, lived from hand to mouth."

Passenger Station, Union Pacific Railway.

The passenger station which we illustrate, is one of the handsomest in the far West, where the tendency is to erect quite handsome stations. The Union station at Denver is a finer building, but not in proportion to the importance of the point. The engraving we give is a reduction of one which appears in the *American Architect*.

The estimated cost is $75,000. The total length, 220 ft., 2 in. Total width, 56 ft. The height, (that is to the top spire) 118 ft. The material of which the body of the building is built, is Fort Collins stone, with La Porte red stone trimmings and slate roof. The ground plan has ladies' and gentlemen's waiting rooms, 52 by 30 ft. each, with adjoining toilet rooms. The large ticket office is between the waiting rooms, with the news and parcel counters in the main part. There is a 14 ft. passage way under the tower, for passage to the platform. The west end has a large baggage room, express room and emigrants' waiting-room, with toilet rooms adjoining.



Passenger Station, Union Pacific Railway, Cheyenne, Wyoming.—Van Brunt & Howe, Architects.

The second floor is to be used by the Superintendent of the Wyoming Division for the train dispatchers, telegraph office, division engineer, supervisor of bridges and buildings, conductors' rooms, and his own apartments. The third floor is to have three large rooms that can be used for reading or lecture rooms.

Photographic Map Reduction.

The Proceedings of the Engineers Club of Philadelphia, for December 1886, just published, contains an interesting paper on the above subject by Mr. O. B. HARDEN, which we abstract as follows:

The camera was first used by the Pennsylvania Geological Survey in 1883, for reducing the large mine maps from 100 to 600 ft. to one inch; it was found to be such a vast saving of time and labor, as compared with the pantograph, that all maps of any magnitude have since been so reduced. Maps of a great variety of scales, from 100 ft. to 1 in. to 6 miles to 1 in., have been so treated, and reduced as small as 10 miles to 1 in. Their accuracy seems in no way to be effected by the reduction. The only difficulty is with colored originals in which blues and purple occur; lines in red of certain shades also require strengthening; green, being made of yellow and blue, often shows a heavy blurred line as a result of the separation of the yellow component. Sharp black lines are the most distinct, and preferable to all others.

In joining maps it is requisite that this be done quickly and with as little paste as possible, as the paper is very sensitive to moisture. This joining is most expeditiously accomplished by overlapping the sections; pricking holes through two common points on each map; mark out and cut off one map to overlap the other by one-half inch; past the lower map and stick the pins back in the same holes as before.

There is practically no limit to the size of a map to be photographed, as only sections 5 ft. square are exposed to the camera at one time for a negative 21 x 25 in., which is the largest made by Bien & Co., the New York firm, which does the Survey work. In reducing to a proper scale, the operator tacks a strip of paper with the original scale marked on it above the section of the map to be reduced, another being cut to the reduced scale is held up to the ground glass of the camera until it is focused to the required scale. The only element of error, aside from the care and skill of the operator, is the expansion and contraction of the sensitized paper. This should, however, come back to its original size after immersion; if it does not an allowance must be made in the scale on the reduced map. Accurate adjustment of the map at right angles to the line of sight is also absolutely necessary. The error due to distortion is compensated for by the combined lenses used for this class of work.

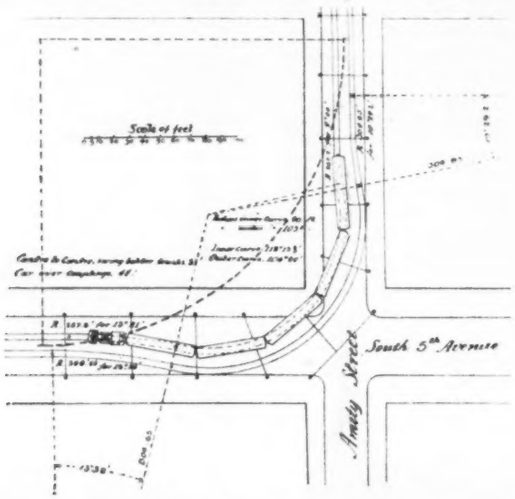
The largest maps reduced for the Survey are the splendid topographical maps of the Philadelphia Water Department for its future water supply. These maps cover 446 sq. miles in Montgomery and Bucks Co. Penna., and have been reduced from 400 ft., to 1600 ft., to 1 in. The area of original map surface is about 773 sq. ft., and that of the reduced map-sheets, 193 sq. ft.: 30 negatives were required for this reduction. In order to prevent any error resulting from shrinkage or imperfect joining of the sections of this reduced map, a templet will be made for the final map, with the lines of latitude and longitude on a polyconic projection drawn upon them as on the original.

A comparison of cost shows a saving of about 40 per cent. over other methods of reduction, when a reproduction alone is required, and where the map will answer its purpose upon the sensitive paper. When the map is to be on tracing cloth or more substantial paper, the saving is about 30 per cent.

THE splendid forthcoming report of the New York Railroad Commission on all the bridges of the State is now in proof-sheets and will make when complete a volume of 1,200 pages. It is as yet uncertain when it will be ready for publication. It will contain strain sheets for every bridge in the State, some 3,500 in all, with many drawings and details, and will be a highly important technical publication if the work is as well done as we anticipate. The checking of the strain-sheets and the inspection work generally has been in charge of Mr. CHARLES F. STOWELL, C. E. Great good has already resulted from the investigation, and more is likely to. We shall give further details of how the work has been done hereafter.

The Sharp Curves on the Manhattan Elevated.

While millions of people have ridden over the curves, which we illustrate, something like 120,000,000 every year, no one has ever yet seen them on paper, so far as we know, except in the drawings in the Company's office, which is certainly remarkable, as to an engineer they are both interesting and instructive. We give them, not as examples to be copied, nor yet as awful warnings, but as showing that many ideas that are common on the question of curvature require modification. No examples are more instructive than examples which go to extremes, and these curves certainly do that, being the sharpest curves in the world, used by heavy traffic.

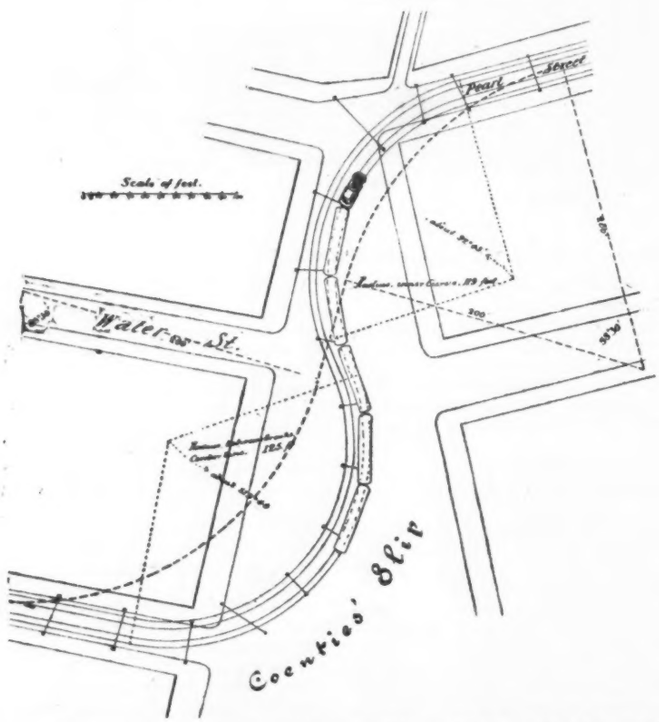


Reversed Curves of 90 ft. Minimum Radius for Turning Right Angles on Manhattan Ry., 6th. Ave. Line.

There are four right-angled turns on the Sixth Ave. line similar in substance to that illustrated. In order to be able to turn within the street limits short reversed curves were introduced, making the total of the central angles 134° 34', or 44° 34' over the necessary right angle. We have dotted on the same plate a curve of 200 ft. radius, or about 29° instead of 63°, not with the purpose of implying that this should have been done by any means (although we do not say that it might not have been well to do so) but for quite another purpose.

The other reversed curve, of 119 ft. radius, or about 48°, is at Coenties Slip, near South Ferry, and is quite unique of its kind. Here likewise we have dotted on possible substitute curves of 200 ft. radius, or 29°, the two alignments comparing as follows as to central angles:

	119 ft. radius	200 ft. radius
1st. Curve	92° 45'	58° 30'
2nd Curve	119° 45'	85° 30'
Total	212° 30'	144°
Difference		68° 30'



Reversed Curves of 119 ft. Radius on Manhattan Elevated Railway, Third Ave. Line.

These curves are of standard gauge, we need hardly say, and the cars are not greatly shorter than are usual on other roads, being about 48 ft. long. Their draw bars, however, go from truck to truck, and not between the car-bodies. The snake-like way in which the train stands on the curve is shown on the cuts, and is very striking even on them, although much more so in the cars themselves, which swing around in a way which is well calculated to alarm the timid.

The number of trains passing over these curves is as nearly as may be 800 *per day*, counting both ways (797 on the Coenties Slip curves, 780 on the Amity St. curves) all of them crowded with passengers as trains very rarely are on other roads. The shortest interval between them is only ¾ minute on the Third Avenue line and 1¼ minutes on the Sixth Avenue line, during the busiest hours. Counting both curves together, more than one-third as many passengers pass over them per year as there are who enter all the trains of all the 125,000 miles of railway in the United States—a fact which few realize. The gross earnings *per mile* mount up to the very comfortable aggregate of $230,000, and the operating expenses to what the greatest surface roads would find the uncomfortable aggregate of $125,000.

The property on the corners which is cut by the dotted curves is in no case particularly valuable. The enormous prices which were asked, because of supposed necessity to purchase, had something to do with their not being bought, no doubt, but $20,000 or $30,000 would have been the greatest net loss which would have been likely to result or would now result from substituting any one of the dotted curves for the constructed curve.

If there was any money in it, we may be tolerably sure that it would have been done before now, but what would be gained by it? The motion around these courses is as smooth and comfortable as need be. A rail would not wear so fast if the radius were twice as long, but as there would be twice as many rails to wear, the gain in that respect is hardly visible to the naked eye, especially as the rails would probably wear more than half as fast. As it is now, there are only 6 or 8 rails to wear for turning a right angle, so that it is hardly a material item to renew them every few weeks. What is true of rail wear is true in substance of wheel wear. As for the curve resistance, experiment and experience seems to indicate clearly that it is only ¼ to ⅓ lb. per ton per degree of curvature, or less than on easy curves. The speed is checked to pass around them, but it would likewise have to be checked to pass around curves of twice the radius, and it would take twice the time to pass them. No accidents of any kind have happened on any of these sharp curves since the roads were opened in 1878.

For these reasons we fail to see how the interests of either the company or the public could be materially benefitted by the longer radii. The only decided element of danger is that a drunk, crazy or forgetful engineer *might* run a train around them so fast as to turn them over into the street. It would take a speed of about 31½ miles per hour to do so, if our memory is correct. But while this danger is a real one, it is not a very great one, with a fireman likewise on the engine.

After making all allowances for differences of conditions, one cannot help thinking how many railways with vastly smaller revenue and traffic, and at vastly greater cost, have spent large sums of money to lengthen radii which were already six or eight times as long as these. It does not necessarily follow that they have done wrongly, but it strongly indicates that many have.

THE last report of VERPLANCK COLVIN, Supt. New York Land Survey, to the Legislature states that ten counties are now under survey including the Adirondack region. Among the numerous maps is one of the western portion of Clinton Co., giving the topography of the Lyon mountain range and the great iron ore region; this map shows over 10,000 acres of State lands, and is of value to visitors and sportsmen as showing the Chateaugay and Chazy Lakes with adjacent mountains, hills, rivers and marshes. Another large map shows the wild region at the head of Cold River in Franklin and Essex counties. This includes the famous Preston Ponds, said to be the best fishing ground in the Adirondack. Supt. COLVIN states that one-half of the Adirondack region is now surveyed, and from the history of this survey we learn that a great portion of this useful work has been done at the private and personal expense of Mr. COLVIN himself.

Steam Heating.—At Boston, Mass., the Board of Alderman has passed an order authorizing the Boston Heating Co., to lay pipes in certain parts of the city. The company is to expend not less than $50,000 and lay not less than 1000 ft. of main pipe with one year from the approval of the order by the mayor. If the company should cease to operate its works for two years t will forfeit all rights.

Cutting off Piles under Water.

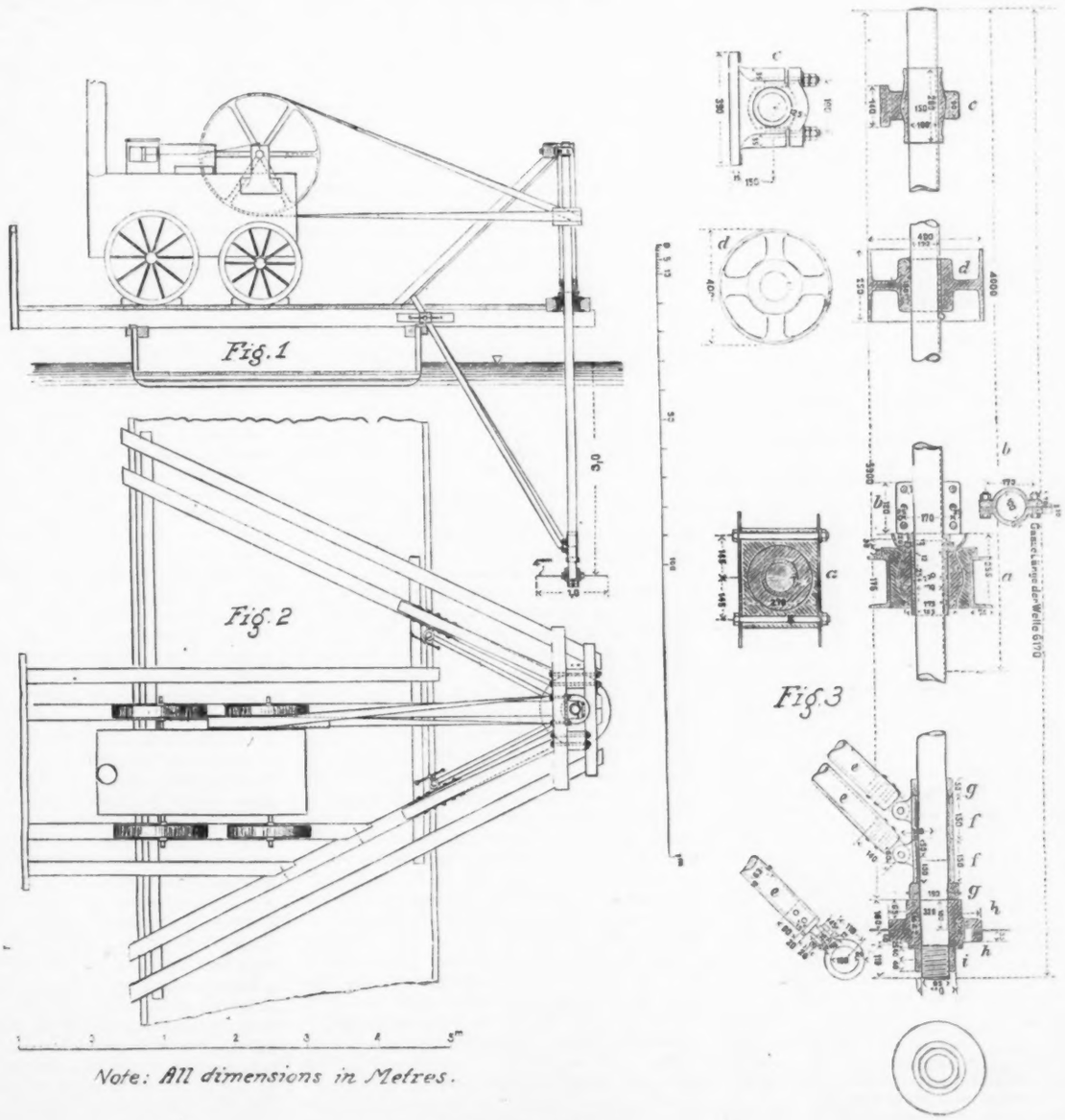
The *Centralblatt der Bauverwaltung*, of December 25, contains the following description and illustration of a saw used for cutting off piles at the draw bridge of Ruhrort.

The saw was mounted on an iron flat-bottomed barge, about 60 feet long by 13 feet beam, or 28 tons measurement. This boat carried a wooden working platform which supported the necessary framework and motive power the latter being a 10 horse-power engine with driving pulley making 120 revolutions per minute.

Opposite the engine and projecting about 6½ feet beyond the edge of the working deck was the framework supporting the vertical saw-shaft. The boat was manouvred by six cables, one attached to either end and two to each side.

The perpendicular saw-shaft (Fig.3), 4 inches in diameter, ran between two adjustable channel-irons, supported on the wooden frame, and with a globe-bearing as shown at *a*; this shaft further adjustable by the clamp and six screws shown at *b*. A cup of phospher-bronze surmounts the globe-bearing and surrounds the shaft. To reduce the friction as much as possible, two steel rings are placed between the cup and the clamp. About 6½ feet above the bearing *a* the shaft is again supported as shown at *c*; and between these two is the driving pulley *d*, 16 inches in diameter. The bottom of the saw-shaft is supported by two diagonal tubular braces attached by hinged connections as shown at *e*, Fig 3; these braces are made adjustable above by passing through a wrought-iron stirrup fastened to the timber-work, and are held in place by strong clamp-screws.

The saw-blade, made of the best steel, was 39 inches in diameter and 0.16 inches thick; the teeth, 62 in number, were of the wolf-tooth type and spread at the points 2 inches. The fastening of the saw-blade is shown in Fig.3; where it is held between two disks forced together by a nut *i* threaded on the lower end of the shaft.



Pile-Cutting Machine.

IN the conservative state of New Hampshire out of $35,000,000 of cash invested in railways, $9,000,000 is said never to have paid any dividends, most of it having been wiped out through bankruptcy proceedings. No corresponding figures exist covering the whole United States, but the proportion is probably even larger.

According to recent statements, the electro-deposition of steel—the principal use for the product being the coating of electotypes for printing with a steel surface, to give them better wearing qualities in the press—is best accomplished by baths formed of the double sulphate of iron and ammonium, or the sulphate of iron and chloride of ammonium. The first of these is prepared either by making a saturated solution of the crystals of the double salt, or by mixing a saturated solution of two salts—the sulphate of iron and the sulphate of ammonium—in their equivalent proportions; or by precipating a solution of the sulphate of iron with carbonate of ammonium, and dissolving the precipitate by the careful addition of sulphuric acid, avoiding an excess of the latter The sulphate of iron and chloride of ammonium bath is prepared either by mixing the two salts together in equivalent proportions, or by dissolving in a saturated solution of the sulphate of iron as much chloride of ammonium as it will take up at the ordinary temperature. All of these baths to be made as concentrated as possible.

THE 68,200 lb. anvil-block, recently cast by the Otis Iron and Steel Co., of Cleveland, for the Morgan Engineering Works, is said to be the largest single steel casting ever turned out in this country. The block is 8 ft. square by 3 ft. 10 in. high; 78,525 lbs. of steel were melted and this was poured in 4 min. 20 sec.

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

TRIBUNE BUILDING, - NEW YORK CITY.

VOL. XVII. Saturday, April 2, 1887

D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $1.50 *per Year, or* 3 *cents per number, additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.*

Employment Notices.—POSITIONS WANTED, *50 cents, for one insertion; $1.00 for three insertions; not over fifty words.* POSITIONS TO BE FILLED. **Free.** *Those having positions to fill are earnestly requested to avail themselves of our facilities, in the mutual interest of themselves and the unemployed.*

As we have stated in our news column the expert evidence so far given in the Bussey bridge investigation, conforms exactly with what we announced as certain 48 hours after its fall, so far as definite and positive statements are concerned. But in what is not said, and in vagueness as to essential matters, it has some extraordinary features. *The whole* truth is even more important than nothing but the truth in such matters, as is recognized in the old legal maxim as to a suppression of the truth (whether intentional or not) having the effect of a suggestion of the false. We fully believe that "this effect defective" was in no way intended, but that it really existed in a rather aggravated form we can illustrate by a single fair sample of a number of other clauses:

"Mr. VOSE testified in regard to the hangers, that it was a *mere matter of guess work to determine upon the quality of their material* at present. [True as to their precise quality, but it was obtrusively evident upon their surface that they were made of badly worked scrap-iron.] If he had seen them before their construction he *should have advised that they should not be put in.* [We hope so.] The welding *was bad.* [The surface indications were that there was no weld at all, except on the edge. Their subsequent fracture showed no worse condition than could have been readily surmised from the outside,] and the principle of an angular strain upon them was also *to be condemned.*" [It threw fibre strains upon them of 20,000 to 50,000 lbs. per sq. in. which ensured their immediate rupture or distortion.]

It was also stated that they could not be inspected, which is true only of those parts of the hangers which did *not* break. The lower ends of the hangers, where the break occurred, were well painted on both the inside and outside, and anything which can be painted as these were, can be inspected by the hand. The rusted, open cracks, which must have been nearly as old as the bridge, could then have been easily felt. Moreover, the form of the hangers was readily visible from the outside, and that alone would have instantly alarmed a competent inspecting engineer, who felt that he was becoming responsible for the future safety of the structure. He would then have known just where to look for a probable break, and putting his hand in where it should be, would have found it. But it cannot be expected that even expert engineers who merely glanced at a structure without that critical anxiety which comes from a professional engagement, should notice such things until disaster brings them into prominence.

One clause from the testimony of Mr. HENRY MANLEY should also be quoted. We can hardly believe that the report is correct, as we are indeed surprised to find it, coming from such a source.

"I don't understand why they [the hangers] were designed in the shape they were. If there had been something between them to keep them apart, *they would have done.* As it was, they were little better than open hooks. [They were worse than open hooks of the same section of metal.] They were so situated in the bridge *that it was impossible to make a proper examination.*" [True of the whole hangers, but not of the parts which broke.]

IT is an ill wind that blows no one good. Our friend CLARK FISHER has gained something very like a card for his joint from the wreck of the Bussey Bridge. It appears that one of the long 60 ft. rails which reached from the bridge over to the abutment was broken off short quite close to the joint, but the end piece remained firmly fixed in the joint and the latter remained intact. The only Autocrat has drawn a moving picture of an empty relic of "Ma'am Allen," declaring on its word of honor as a bottle that it was not a die. So we may imagine this masterpiece holding up both arms of its U-bolt, amid the wreck of matter and the crash of cars, to declare upon its word of honor as a rail-joint that it is not a chair. "Whatever else pa is," said LAVVY, "he is not a female," and we think the case is pretty well made out that whatever else the joint is, it is not a chair.

A GOOD story is told of the designer of the well known Howe truss that seems especially seasonable at this time. We tell the tale as t'was told to us, but in substance believe it was true.

The scene was the official inspection by its directors and officers of a railroad upon which were several Howe bridges constructed originally of very green hemlock timber; Mr. HOWE himself was one of the party and the liquid supplies provided had exchanged packages to the extent usual on similar occasions. A halt was made at one of these bridges and an officious director felt called upon to test the structure according to his lights. A faulty spot in a diagonal attracted his attention, and a few vigorous pokes of a stout cane broke through the outer shell of still sound wood and he commenced to rattle down the rotten material from within. Growing excited over his discovery, he shouted out, with a vicious poke at each clause: "Just look here, gentlemen.—Great Scot!—what holds this bridge up?"

Mr. HOWE overheard the query, and feeling that his professional offspring was being somehow assailed, braced himself up and with virtuous indignation answered back: 'What holds that bridge up, sir? Why (hic) its' the pr-pr-principle, sir—the principle."

And HOWE was right; even the worst of his bridges had a pr-pr-principle to support it; which is more than can be said for some others that have recently become prominent.

THE Boston & Providence Railroad is, we believe, the only one in the country provided with kilometer mile-posts. The posts are of stone, neatly engraved, massive, solid and substantial, and of excellent design.

WE have been reminded that we have not stated, what it should be hardly necessary for us to state, that immediately after the fragments of the lower halves of the Bussey bridge came into our possession, we advised the chairman of the commission by letter, that we held them subject to his order. Two days later they were returned accordingly.

The Car Heating Question.

The indications multiply that this winter's many dead in car stove accidents have not died in vain. All that has been necessary for some years was to have the question taken hold of in earnest, in a favoring and not adverse spirit, and the needed impetus has come. So many reports come in of successful tests in various directions, and so few (in fact, none) of an adverse character, that it seems extremely probable that steam heating from the locomotive may be common even by next winter, and in a year or two longer may become almost universal. The truth is, that there never has been any real difficulty about the matter other than the two great ones which always stand in the way of such improvements: that the first attempts are sure to have objectionable imperfections of detail which experience, and nothing else, will suffice to fully eliminate; and that this experience can only be gained by *faithful* efforts to eliminate them. Until some great public demand arises, or the necessity becomes otherwise so clear that it cannot be ignored or postponed, these two difficulties stand in the way of all such improvements, and not unnaturally. In the steam-heating question, the objection that steam could not be spared from the locomotive, which seemed so plausible and practical a point, but which we showed in our issue of Feb. 19 to have no foundation whatever in fact, has been a further and great obstacle.

Besides the various other modes of heating which we have noticed, the Pennsylvania company has recently made a successful test of the "Erie Standard" car heater, if the newspaper statements are correct, and an entirely successful trip with twelve cars has recently been made in Maine. The New York Central seems to be already entirely converted, in spite of Mr. CHAUNCEY M. DEPEW'S previous (very previous) condemnation of steam heating as an absurd and chimerical idea, and it is announced as probable that equipping of the entire stock of the Wagner sleeping cars will be rapidly proceeded with.

The most important fact of all, and certainly the most honorable, is the prompt and complete retractation by the New York State Railroad Commission, which we noted last week, of the rather absurd action they took only four weeks ago, to the effect that steam heating was impracticable, and that car-stoves could be built like a monitor turret which would be perfectly safe even in case of a collision. The unfortunate character of this report, and its erroneous technical conclusions, we took occasion to point out in our issue of March 5. The Commissioners have now answered themselves on the same matters, in the following words:

"If so constructed as to withstand the shock of collision, car-heaters inside of cars will have to weigh from 600 to 800 lbs., and thus they might inflict personal injury in cases where cars are overturned or rolled down embankments. Their weight and momentum might also cause very serious results to passengers in collisions and other accidents accompanied by a severe shock. They are to be dreaded even where water bases or other fire extinguishing devices are used. Should an accident happen, as it well may, at the moment that a heater is open to receive coal or to be otherwise tended, or when carelessly left open, the present danger of setting fire to the car would be added to those caused by its weight and momentum."

To this the Commission added that the most that can be expected of any such heater is to diminish but not remove the danger of fire, while on the other hand they say of steam heating:—

"The steam heating system has been practically tested to an extent that warrants the majority of the commissioners in saying that under all ordinary circumstances it can be adopted by railroads upon trains of from 3 to 7 cars, without serious apprehension of failure from the following causes: (1) The inability of the engine to furnish steam enough. (2) The danger of freezing at the couplings between the cars on account of the collection of water where the pipes settle below a level, and also in the traps which are necessary on any system of heating using steam pressure. Whether long trains of from 10 to 14 cars can be heated satisfactorily by steam, is a serious mooted question. It has not been done at all even under favorable conditions. Master mechanics believe this can be done, but they ask for time to make experiments."

The last doubt is measurably settled by the Maine test above alluded to, and independent of that, we may again repeat that it is wholly beyond doubt that sufficient steam to heat the longest train of passenger cars can readily be spared, and with but very trifling addition to fuel consumption, if any. The whole difficulty lies in the distribution of the steam. This results chiefly from the fact that it is only during a fourth or a fifth of the time on every run that the full steam power of the engine is needed. When running down hill or on a level, or when standing at a station, 5 or 10 per cent. of the steam which the boiler can generate can be spared for heating as well as not. Moreover, since 5 per cent. of the average steam-generation of a locomotive will suffice to heat a train of 14 or 15 cars, we have only to decrease the speed 5 per cent., or cut off one car in twenty, or save about half of the 10 per cent. of loss by radiation from the unprotected fire-box sheets, and we have at once enough steam to spare for heating purposes without relying on the intermittent character of the regular demand.

The new report is not wholly unanimous, Commissioner ROGERS having dissented from the main report so far as it tends toward making steam heating mandatory, "for the present at least," while Commissioner O'DONNELL dissented from the former report in favor of car stoves. But for practical purposes the new report is unanimous, and no more honorable act is embodied in the records of the Commission. Of all hard food to take eating one's own words is the hardest. That the Commission should have been willing to do this, and to do it so promptly, in the interest of the public and of human life, will long be remembered in their favor, for they might at least have put the matter off for some months longer, and no one would have thought of blaming them.

A Lesson to Engineers.

There is one plain moral of the late Forest Hill disaster—and perhaps, in the end, the most important one to engineers as such—which it is to be hoped they will observe and act upon; the absolute necessity of having some great national organization, like the American Society of Civil Engineers, which shall include in its membership all engineers who have shown competency for responsible charge of engineering work by retaining it for at least one year, and shall rigidly exclude all others from its highest grade. Speaking from no love for that society as such, nor desire to aggrandize it, but solely in the interest of the whole profession everywhere and of all grades of experience, we earnestly hope that the time will soon come in this country, as it has already in England, when it will be impossible for a man to earn his bread in responsible engineering positions unless he is a member of that organization. Had it been so, it is at least possible that there would have been no Bussey bridge disaster, for although there is no magic in membership of such an organization to change poor men into good ones, yet certainly there is nothing which can so directly tend to exclude extreme incompetency from high positions as the existence of an organization which includes *all* those of a certain recognized professional standing, and endeavors to admit no others.

We say this, we repeat, from no such Quixotic delusion as that the mere fact of membership can ever be a guarantee of professional qualifications. In any large body of the kind there must ever be men who could not safely be trusted to design a wood-shed. But what such membership can do and does do, is to insure that such in capacity *is not known to exist*, and that is no small gain.

Thinking men who feel an interest and pride in their profession, must see that the best interests of engineers of all grades of experience, as well as of the public generally, demand that there should be such an organization, which is not purely confined to scientific purposes, but which in effect endorses a man as qualified by experience for a certain minimum of responsibility when it elects him to membership. There could be no better proof of this than this last disaster. The designer of the bridge which fell was not, so far as we can learn, a member of any engineering organization, and it will be clear enough to engineers, who can read between the lines in another column, that he could hardly have become a member of the American Society at the time when he *began* to erect his remarkable bridges on his own account, had be applied. Therefore, had it been the custom of the public to demand that a man must have this presumptive evidence of competency before entrusting him with responsible duties, he would have been unable, had he been so disposed, to have begun erecting bridges until there were no five engineers in the country who thought him unfit for responsible work in his specialty. Would not this be well for all?

We trust it is needless to add that we say this only to use a public incident for the public good while it is fresh in the minds of engineers, and not to increase the burden upon an unfortunate man whose only fault was ignorance. No man can be severely blamed for not realizing such ignorance himself, if the public choose to pay for it as knowledge, but surely it would have been well for him and for every one had he been compelled to pass the trifling ordeal of a ballot of the society before he could have even attempted with success to design structures on which human life depended. It can never be a perfect protection but it is some protection; and moreover, it is at least possible that an engineer otherwise unworthy of real responsibility will reap this further gain; that he will be inspired by the contagion of example to recognize his deficiencies, and by seeing the thorough way in which other engineers are studying the details of their profession will be led to correct them. *Esprit du corps* is a great force. It cannot safely be ignored.

Signs are not wanting, however, that it will be before long almost a professional necessity for civil engineers to belong to the national organization. As yet this is hardly so. There are still a great many engineers of high standing in various parts of the country who are not members of it, but already they are a decreasing minority among the engineers of really established position, and it may fairly and truly be said that, already the time has come when it raises a certain shade of legitimate doubt about one side or another of a man's professional character that he does not belong to it.

These questions are even now asked, and surely they are fair ones: WHY does he not belong to it? Is it because he cannot get in from lack of professional qualifications? Or is it because he does not take interest enough in his profession to care to support and strengthen such an organization? Or is it because he has made enemies by personal or professional misconduct, so that he fears to apply for membership? Or is it that he finds no pleasure in the acquaintance of his fellow-engineers, and in the instruction to be had in meeting with them?

These questions *are asked*. Every year they will be asked more, and in either case it is apparent that the answer cannot be entirely to a man's credit. If he have not enough of interest in his profession to desire to strengthen the only possible national organization of civil engineers—a desire which does not at all imply that he desires to be bolstered up by it himself, but does imply that he takes an interest in his profession beyond the mere money which he takes out of it, it certainly indicates that there is something peculiar in his character.

The Spring Valley Water Pipe.

As addenda to our remarks on the wrought-iron pipe made for the Spring Valley Waterworks by the Risdon Ironworks of San Francisco, and published in our last issue, we give some further data since obtained through Mr. ED. BATES DORSEY, M. Am. Soc. C. E.

This company contracted to furnish complete and lay 200 ft. of 44-in. wrought-iron pipe daily within two weeks, 400 ft. daily within three weeks and 600 ft. daily within four weeks of date of contract, and to continue at the latter rate. The company actually averaged 850 ft. daily for many days, and could easily have completed 900 ft., or over one mile per week. The pipe was completely buried in the ditch and all joints riveted hot in the ditch, and cold in the shop by hydraulic riveters. There were no provisions made by slip-joint or other device for expansion and contraction in this 27 miles of large pipe; and so far at least no such precaution seems to be required as the joints are all water-tight.

This pipe was dipped at the works in a bath of asphaltum, coal-tar and lime, at a temperature of 380° to 450°. This coating is practically indestructible and thoroughly protects the pipe from rust. A similar coating after 30 years use seems as good and strong as when first put on.

The Spring Valley Water Company expects to soon enlarge its supply by a 24 mile line of 5 ft. pipe across the San José Valley, with a vertical water pressure upon this line of 500 ft

PERSONAL.

R. E. HARDAWAY, Chief Engineer of the Americus, Preston & Lumpkin R. R., has resigned and will take up his residence at Tuscaloosa, Ala.

REUBEN R. MARBLE has been appointed City Civil Engineer of Columbus, O., in place of JOHN GRAHAM, who has resigned.

HOWARD CARLTON, Master Car Builder of the Baltimore & Ohio R. R., at Newark, O., has resigned to accept the position of Superintendent of the Curtis Car Works, in Maryland.

GEORGE A. ELLIS, of Springfield Mass., who was Chief Engineer for the construction of the waterworks at Racine, Wis., has completed his work and returned east. The contractors for the works were TURNER, CLARK & RAWSON, of Boston.

CHARLES A. ASHBURNER, Geologist of the Pennsylvania State Survey, has resigned his position, and has associated himself with Mr. GEORGE WESTINGHOUSE, JR., in a project for introducing fuel gas and electric lighting in various cities.

E. A. FLEWELLEN, Chief Engineer and General Manager of the Columbus & Western R. R., has resigned and F. Y. DABNEY has been appointed Chief Engineer. The road extends from Columbus, Ga., to Goodwater, Ala., and is being extended to Birmingham, Ala.

COL. WM. H. STEVENSON, President of the New York, Rutland & Montreal R. R. Co., has been elected Vice President of the Housatonic R. R. Co. W. E. DOWNS, of Derby, Conn., has been elected a director, in the place of HENRY Y. LEAVITT, of New York, who has resigned.

SIR JOSEPH WHITWORTH, left a personal estate of $1,812,500. He left $500,000 as a capital for the fund to promote the Whitworth scholarship; $10,000 to the Institution of Civil Engineers; $5,000 to the Institute of Mechanical Engineers and bequests to other societies.

CORRECTION. Misled by a contemporary we incorrectly gave, in our issue of March 19, an item of news concerning Gen. LOUIS WAGNER. This gentlemen was appointed Commissioner of Public Works of Philadelphia, Ex-Mayor W. S. STOKLEY was made Commissioner of Public Safety.

MAJ. W. H. MCCLINTOCK, has been appointed Division Superintendent of the Columbus & Western R. R., with headquarters at Columbus, Ga. He was formerly Road Superintendent of the Louisville & Nashville R. R., then Assistant Engineer of the Southern division and afterwards Resident Engineer of the Western Railway of Alabama.

The following board of officers of the Pennsylvania R. R. Co. have been re-elected: President, GEORGE B. ROBERTS; First Vice President, EDMUND SMITH; Second Vice President, FRANK THOMSON; Third Vice President, J. N. DUBARRY; Fourth Vice President, J. P. GRAU; Secretary, JOHN P. GREEN; Treasurer, ROBERT W. SMITH; General Solicitor, JOHN SCOTT. All the other officers were reappointed by the President and confirmed by the Board of Directors.

CORRESPONDENCE.

Slip Switches.

MILFORD, N. H., March 28, 1887.

EDITOR ENGINEERING NEWS:

I should like to know through your paper, if convenient, what has been found to be the best angle for slip switch crossings in railroad construction.

Yours truly, C. H. BARTLETT.

[So few slip switches have been used, in this country at least, that there can hardly be said to be any rule, and perhaps a majority of engineers do not yet know what they are. The slip switches of the yard of the Grand Central station, in this city, which is one of the best and most extensive examples of their use, are laid out at an angle of 16°, or about 1 in 3¼. There is no mechanical reason, however, why they should not be laid out at any angle from 1 to 3 to 1 to 5 or 6.—ED. ENG. NEWS.]

The Exact Condition of the Hanger Fractures.

BOSTON, MASS., March 28, 1887.

EDITOR ENGINEERING NEWS:

In accordance with your request, I have carefully examined both halves of the pieces of the broken hangers of the Bussey bridge, now in the possession of the Railroad Commissioners, and report as follows:—

First. The upper fractures of the broken hangers corresponding with those illustrated, and lettered *A*, *B* and *C*, in ENGINEERING NEWS of March 19, are identical in appearance with the lower halves, formerly in your possession, and exactly agree with your illustrations and descriptive notes. The upper part corresponding with *D*, as well as all the others, *match* perfectly, and the surfaces of *C* and *D* show large bright crystalline particle, but the part which remained in Boston, corresponding to that illustrated by *D* in your engraving, has not the two appearances (of old fractures, ED.) shown in your illustration and by the piece itself, but is of an uniform appearance.

Secondly. There are several bright surfaces still remaining, showing fresh breaks, the most exposed points being covered with a light yellow rust, and the dark portions shown in your illustrations are covered with a brown and evidently old rust, no bright surfaces showing in these parts. There are bright places along the right edge of the part *B*, which evidently was the only part which held the two pieces together. The piece corresponding to that illustrated by *D* is of an uniform gray color, caused possibly by lying in the mud, which has also prevented its rusting. The part, formerly in your possession is the only piece which shows what connection held the two halves together, as the old and new broken surfaces do not show in the other piece. There are two other hangers in the possession of the Commissioners which are equally bad, both hangers showing separation of the welded surfaces as at *A*, *B* and *C* of your former illustrations.

Yours truly, FRANCIS E. GALLOUPE.
Mechanical Engineer.

30 Kilby St., Boston, Mass.

[The above professional opinion as to the character and condition of the other fractured surfaces of the "Tin Bridge" hangers was called out by a request from us to have the fractured surfaces compared of the parts which we took care of, and of the parts which were taken care of in Boston, with a view to ascertaining whether or not the information which reached us from other sources was correct, that the only evidence which now existed of the true character of one of the fractures was that which we were, so very unexpectedly, the means of preserving.

It will be seen that this letter fully confirms our other information, and explains the statements which appeared in the Boston papers that the fracture *D* was a new fracture, whereas we had preserved the clearest evidence that it was not. To be sure, there was still evidence enough left to show that the hangers were almost incredibly bad, both in form and material; but it is needless to say that in cases of this kind the public interest demands that it should be fully shown not only that the broken parts were bad, but precisely *how* bad.—ED. ENG. NEWS.]

Too Many Knobs.

ON THE TRAIN, Mar. 24, 1887.

EDITOR ENGINEERING NEWS:

As I am spending about four nights out of the seven in riding in "sleepers," I have a suggestion to make regarding the lunatic who designed them; and that is that he place a few more knobs and points on the lower side of the upper berth.

The designer has probably never slept in one of his own cars, or he would appreciate the exquisite pleasure to be derived from having his head gently scratched with each unexpected motion of the car, especially as he tries to pull himself together into shape sufficiently presentable to make his morning pilgrimage to the wash-room end of the car.

To make the case perfection all that is required is to lower the upper berth about 4 in., to bring more of the surface of the sufferer under the influence of the impromptu curry-comb, and to work in a P. P. C., monogram in conical-headed nails, to fill in the few voids between the afore-mentioned knobs and points.

In all seriousness, however, I do wish to call attention to a feature of Pullman-car decoration which is now a public nuisance and demands speedy improvement. Yours truly, T. J. L.

[The case made out by our correspondent is too obvious to require any endorsement; every night traveler has probably had a similar pointed experience. Plain surface decoration can be made quite as esthetically effective and the objectionable relief ornaments be dispensed with entirely, and thus please the eye and save the head of the traveler at one and the same time.—ED. ENG. NEWS.]

The Middle Panel Hangers of the Bussey Bridge.

BOSTON, MASS., March 26, 1887.

EDITOR ENGINEERING NEWS:

On page 208 of to-day's ENGINEERING NEWS, in speaking of "The Fateful Hangers," you state you do not know the condition of the hangers at the middle panel. There were no hangers there. The casting against which the top chord abutted on each side, with small lugs, was similar to the end ones only, each face was plumb and 12 in. apart. Here was the pin, the same as at the end casting, but it only held the diagonal rods of the truss. The floor-beams also had a 4 in. pin, like the other, but it had a coat of paint on it between the I-beams, as if no hangers had ever been there. They rested on a a heavy casting 6 in. deep, square on top, and hexagonal below, where it rested on the middle column of truss. The floor-beams were held in place by short lugs in each of these castings, which set in spaces cut out from flanges of the I-beams.

Yours truly, H. DICKINSON.

[This helps to clear up the mystery as to how such hangers ever held up a train even for a single year, since there are only two panels, instead of three, to wonder at.

Another correspondent writes us to the same effect, as indeed was clear enough from the engraving of the bridge which we published. The support of the floor-beam at the middle panel was wholly left to the remarkable post in the middle of the truss, of which indeed it constituted a part.—ED. ENG. NEWS.]

The Use of Cement Pipe for Sewers.

RACINE, WIS., March 25, 1887.

EDITOR ENGINEERING NEWS:—

Under the above heading, in your issue of April 17, 1886, which has just come to my attention, I find a rather savage attack on "Cement Sewer Pipes." Anyone acquainted with the sewer pipe trade will readily perceive the reasons for many of the opinions expressed therein, but it would be out of place in this communication to call attention to particular instances. Cement pipe is used in far larger quantities now than ever before, and the trade is rapidly increasing. I copy extracts from a few of a large number of letters in my possession.

ANDREW RINKER, City Engineer, Minneapolis, Minn., writes: "We do not allow any stone (clay) pipe to be used for street sewers. In our view good cement and sand, properly compounded and rammed makes a better material for sewers than any clay or stone pipe we are acquainted with. The use of cement pipe will be continued. We consider it the best material to resist acids."

H. D. LUDDEN, City Engineer, Detroit, Mich., writes: "The city prefers the cement pipe because it is less liable to breakage from unequal settlement of the earth, and also resists the action of frost better than the clay pipes when exposed."

W. H. HEARDING, U. S. Engineer, Milwaukee, Wis., writes: "The acids in general sewage matter do not affect the cement pipe as has been frequently proven." G. H. BENZENBERG, City Engineer, Milwaukee, Wis., writes: "We have used cement pipes for sewers in this city for the past 15 years, and are extending our sewer system by the use of them each year."

C. M. SLOCUM, City Engineer, Springfield, Mass., writes of cement pipe, "It has generally given us very good satisfaction."

C. A. ALLEN, City Engineer, Worcester, Mass., writes: "The City of Worcester has always used cement pipes for sewer purposes. We have never had trouble with them, and have pipe in use that have been laid 15 years."

ANDREW HABEN, Mayor of Oshkosh, Wis., writes: "In advertising for bids we specify cement pipe. Have laid nearly 10 miles of them, and have yet to find one that has given out."

W. F. GOODHUE, City Engineer, Racine, Wis., writes: "I have used the cement sewer pipe made by you and have also used it largely in the East and prefer it to any other kind, especially for permament work. I think cement pipe can be more readily and safely tapped without damage which is oftentimes an important consideration in making sewer connections."

CHAS. J. CHAPMAN, Mayor of Portland, Me., writes: "So far as I can learn from the engineer and committees in charge of sewers the cement pipe has given excellent service, and is regarded as the most suitable for the construction of sewers."

JNO. T. HILTON, City Surveyor, Paterson, N. J., says: "I have specimens of vitrified and cement pipe in my office which have been in service for years, an examination of which will convince most persons that the latter material is superior for sewers."

These extracts are from but a few of many letters of the same purport and I will not ask for space enough to publish the rest, which are but repetitions of what is contained in the foregoing. Brooklyn

N. Y., and Milwaukee, Wis., are the largest users of cement pipe in this country, and I would suggest that parties interested write to the proper officials for opinions. I trust that this will find space in your journal in the interest of fair play.

Very respectfully, H. VAN ARSDALE.

[As the letter objected to present the views of the advocates of salt-glazed vitrified pipe, we take pleasure in presenting the other side of the case as given above. Users must decide between them for themselves as controlling conditions seem to demand.—ED. ENG. NEWS].

The Design and Strains of the Bussey Bridge.

EDITOR ENGINEERING NEWS:

The failure of the Bussey bridge near Boston, on March 14, 1887, with the terrible loss of life which followed, was an event of such importance that the following investigation into the design of the structure may be of interest.

The writer has chosen the northwestern or four-panel truss, the one which was the most loaded and the first to fail, and endeavored to show the probable strains in the structure at the time of the accident, and for this purpose has assumed the loads given in the cut herewith. The load which such a bridge should be designed to carry would of course be much larger. For instance a "consolidation" engine weighing 111,000 lbs., and tender weighing 60,000 lbs., together with the dead load, would bring a strain on the hangers which broke, at U, of about 86,500 lbs., while the strain from the loads assumed would be but 64,500 lbs. The structure was a deck bridge, and the floor beams were suspended by hangers from the top chord of the northwestern truss. ENGINEERING NEWS, for March 19, shows the general construction. In the plan and diagrams given, the depth of the truss, width of the bridge and position of the track are approximate estimates from which the accurate measurements when ascertained may vary slightly. The train came on the bridge at U and moved toward U_0.

Posts $U_1 L_1$ and $U_2 L_2$ were so designed that they could not take tension, so the dead load at L_1 and L_2 was transferred by a secondary system of trussing to U_2.

Compressive strains are indicated by + in the table below, and tensile strains are indicated by —. On the diagrams tension or compression is indicated by the direction of the arrow-heads.

(*See table.*)

The above strains are a maximum except for the member $U_3 L$, for which the minimum is given.

The maximum load on the hangers at U_1, occurred when the second driver of the engine was over that point. The bad design and defective character of these hangers has been so fully treated and shown in ENGINEERING NEWS that it is not necessary to emphasize the facts.

Assuming that they broke under the maximum load, the strains in the truss must have been considerably modified. The modified strains are easily calculated, however, as follows:

Refer to diagram No. 2:

$i = 58° 28½'$, $tan.\ i = 1.625$, $sec.\ i = 1.906$.

Reactions are found by taking moments about L_4.

Compression indicated +, tension —.

$R = 97100$.

$L_0 U_1 = + 97100\ sec.\ i = + 185300\ lbs.$

$L_0 L_1 = - 97100\ tan.\ i = - 157800\ lbs.$

$U_1 L_2 = - (97100 - 8000)\ sec.\ i = - 89100\ sec.\ i = - 170000\ lbs.$

$U_1 U_2 = + (97100 + 89100)\ tan.\ i = + 186200\ tan.\ i = + 302600\ lbs.$

$P_1 L_1 = + 64500\ lbs.$

$L_1 U_2 = - (64500 + 4000)\ sec\ i = - 68500\ sec.\ i = - 130700\ lbs.$

$L_1 L_2 = - (97100 - 68500)\ tan.\ i = - 28600\ tan.\ i = - 46500\ lbs.$

$U_2 L_3 = - 4000\ sec.\ i = - 7600\ lbs.$

$U_2 L_2 = + (57500 + 68500 + 4000) = + 130000\ lbs.$

$U_2 U_3 = + (186200 + 4000 - 68500)\ tan.\ i = + 121700\ tan.\ i = + 197800\ lbs.$

$U_3 L_3 = 0.0$ Amount of compression indeterminate but as it must be very small, it is assumed as zero.

$L_2 U_3 = - (130000 + 4000 - 89100)\ sec.\ i = - 44900\ sec.\ i = - 85700\ lbs.$

$L_2 L_3 = - (28600 + 89100 - 44900)\ tan.\ i = 72800\ tan\ i = - 118300\ lbs.$

$L_3 L_4 = - (72800 + 4000)\ tan.\ i = - 76800\ tan.\ i = - 124800\ lbs.$

$U_3 L_4 = + (121700 - 44900)\ sec.\ i = + 76800\ sec.\ i = + 146500\ lbs.$

$R_1 = 76800$.

It may at first seem improbable that tension could exist in both $U_1 L_2$ and $L_1 U$, but an examination will show that $P_1 L_1$, $L_1 U_2$, and $L_1 L_2$ act as a secondary system, transferring the load to the middle post $U_2 L_2$ and that $P_1 L_1$ and $L_1 U$, are not members of the truss proper.

That tension will be produced in both $L_1 U_2$ and $U_1 L$ by a load applied at L_1 may be readily shown by a model made with pasteboard or strips of wood and pins, in accordance with diagram No. 2. The strains in $L_1 U_2$, $U_2 L_2$, $L_2 U_1$ and $U_1 U_2$ were greater and the strain in $L_1 L_2$ less than before the hangers broke. These strains depend on the ability of $P_1 L_1$ to transfer the load to the other members as indicated. The strain in $P_1 L_1$ was increased from zero or from a small compression to a compression of 64500 lbs, applied suddenly; $P_1 L_1$ was a 5-in I-beam with a sectional area of 3 sq. in. and a radius of gyration of 0.6.

It was about 14 ft. long so that $\frac{l}{r} = 280$.

Judging from the experiments made at Pencoyd, this 5 in. I-beam would fail by deflection at a strain of 8,500 lbs. per sq. in. or 25,500 lbs. total. It was therefore strained by a moving load to more than twice the amount that would have caused its failure if the load had been applied with all the care and precision of a laboratory test. That this I-beam could not have stood the strain, there can be no doubt but it may have eased the fall of the floor-beam. Its failure would have still left the truss intact.

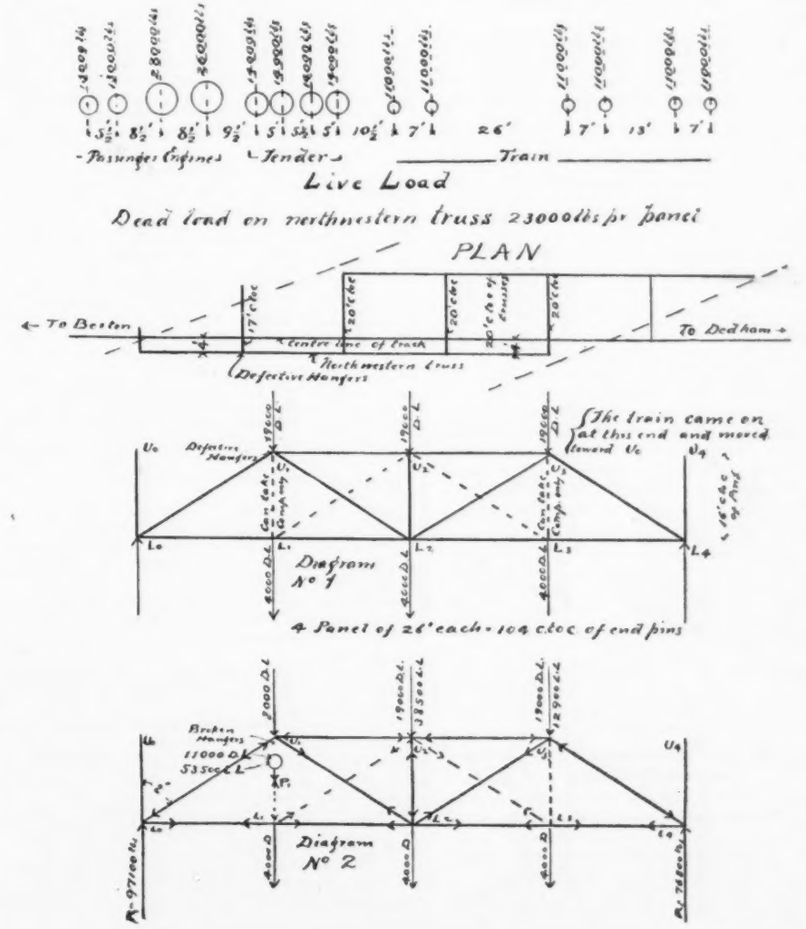
$L_1 U_2$ must have been greatly overstrained, but unfortunately the writer does not know its sectional area. If it failed before $P_1 L_1$ it would have been immediately followed by the destruction of the truss.

While the character of the hangers alone, is amply sufficient to explain the disaster, the above computations help to explain why the failure did not come sooner than it did, and why, after they had broken, the floor was still held up after a fashion, so as to let two or three more cars escape.

Yours truly,

HENRY S. PRICHARD.

Member.	Dead Load Strains.	Live Load Strains.	Combined Strains.	Position of Engine.
	Lbs.	Lbs.	Lbs.	
$L_0\ U_1$	+ 65800	+ 125100	+ 190900	1st driver at U_1.
$U_1\ U_2$	+ 81200	+ 140200	+ 221400	2nd driver at U_2.
$L_0\ L_1$	— 56100	— 106500	— 162600	1st driver at U_1.
$L_1\ L_2$	— 49600	— 106500	— 156100	1st driver at U_1.
$U_1\ L_2$	— 29600	— 68200	— 97800	1st driver at U_2.
$L_2\ U_2$	— 7600	0.0	— 7600	
$U_2\ L_3$	+ 27000	+ 35700	+ 62700	1st driver at U_3.
$U_2\ L_2$	— 29600	+ 16700	— 12900	1st driver at U_2.
Hangers at U_1.	— 11000	— 53500	— 64500	2nd driver at U_1.


Live Load
Dead load on northwestern truss 23000 lbs pr panel
PLAN
To Boston
To Dedham
Centre line of track
Northwestern truss
Defective Hangers
The train came on at this end and moved toward U0
Diagram No 1
4 Panel of 26' each = 104' c to c of end pins
Broken Hangers
Diagram No 2

Diagrams of the Bussey Bridge.

Re-Railing Bridge Safety-Guards.

NAPANEE, Ont., March 14, 1887.

EDITOR ENGINEERING NEWS:

Replying to Mr. J. W. SCHAUB, in your issue of March 12, if he will read my note in your issue of Feb. 26, he will see that I did not claim for Mr. PETERSON the arrangement of the guard-rails; merely the massive masonry built in such a manner as to protect the end-posts. The design he sketches has not been carried out in its entirety. The frog point A in his sketch has not been built on any of the bridges I have seen. The drawing I sent you

(see issue of Feb. 26) was made from actual measurements taken from Arden bridge on the Ontario & Quebec Division of the Canada Pacific Railway. Similar arrangements are placed on bridges of that division at Tweed, Peterboro and several other places where I have particularly noticed them. I remember reading an article on the protection of bridges some eight or ten years ago in the *Canadian Mechanics' Magazine* by Mr. P. A. PETERSON, which advocated the *widening* of all through bridges; the constructing of a massive masonry guard, and the building of stronger and closer spaced floors. In answer to your query appended to my note as to "what would become of the massive masonry if a car struck it, and of the car and bridge as well," I have never seen the experiment tried, but I feel quite sure it would be bad for the car.

Yours truly, M. J. BUTLER.

Akron Cement.—A Correction.

WASHINGTON, D. C., March 22, 1887.

EDITOR ENGINEERING NEWS:

Inclosed you will please find a circular letter of the "Union Akron Cement Company" of Buffalo, N. Y., which has just come into my possession, containing so far as I am concerned, misleading statements in regard to the qualities of that cement. It appears therein that the "Akron Star Brand" was used on the public works in the District of Columbia, and, consequently, had been officially tested in my laboratory here, and partly made a subject of my annual report to the Commissioners of the District of Columbia, for the past fiscal year, a copy of which was published in ENGINEERING NEWS of Nov. 27, 1886.

The true facts are that the "Akron Star Brand Cement" has never been used on the Public Works here, that it has never been tested by me, and that I am entirely ignorant of its qualities, whether good, bad, or indifferent, for which reason it has never received my approbation or disapprobation.

The Hydraulic Cement tested by me, under the name of "Akron Cement," the qualities of which were reported upon by me, in my annual report above mentioned, is the "Akron Hydraulic Cement, OBELISK Brand," manufactured by the "Standard Cement Company," of Hartford, Conn., and was sold in the District of Columbia, by their agents, Messrs. MARTIN & WILSON, of Washington City.

Disclaiming to give the results of a test not made, or even an opinion of a cement with which I am entirely unfamiliar, I trust you will give this letter a space in your valuable paper, so that dealers and builders may not be misled by the pretended approbation by me of the said cement.

Yours truly,
E. J. DE SMEDT.
Chemist, General Inspector of Cements.

Testimony of the Designer of Half the the Bussey Bridge.

In one of the earlier days of the official investigation of the fall of the Bussey bridge, Mr. E. H. HEWINS, the designer of the newest half of the bridge, gave his professional record as follows:

My name is EDMUND H. HEWINS; am 41 years old; live on Tremont St., Boston; was the builder of a portion of this bridge. The contract required me to build a truss to be placed upon the westerly side of the bridge, or on the side nearest Boston, replacing an iron truss which had been there for some years, and which was to be placed on the easterly side of the bridge; and I was to furnish a floor system. That was done in the spring or early summer of 1876. I was in business for myself; it was my intention at that time to organize a bridge company, but that organization was never consummated; my first experience in building iron bridges was with the Detroit Bridge & Iron Works of Detroit, Mich., I think in 1863; I am not sure whether this wasn't the last bridge that I built; since then I have acted occasionally as consulting engineer; I was at the Lawrence Scientific School at Cambridge one year; then went to Detroit, where I was employed by the Detroit Bridge & Iron Works to design their bridges; designed one across the Mississippi river where C., B. & Q. Railroad crosses it, at that time the longest drawbridge in the world; built several other bridges on that road, and the Illinois Central road, and in several of the Western States; afterward went South for one winter, returned North, and was employed by the Moseley Iron Works, and the New England Iron Company as engineer; then built some bridges on my own account, at least until this bridge was built; I don't recollect one in Massachusetts; can't tell how many I built before the Bussey bridge; think it was somewhere in the neighborhood of half a dozen; the main tension bars of the bridge were furnished by the Phœnix Iron Works; the rest of the material was furnished by, and the work done in the shops of the Trenton Iron Co.; the work done was from designs made by me; this bridge is a very sharp "skew," an angle of 21°, if I remember rightly; the center of the truss on one side is exactly opposite the end of the truss on the other; the theoretical length of the spans is 104 ft., and the theoretical depth of the truss 26 ft., divided into four panels; at each point a floor beam truss extended across the bridge at right angles; the other end of the floor-beam truss rested upon the abutment; upon the floor-beam trusses were the stringer trusses, each of which was directly under one of the rails; the bridge was proportioned to carry an evenly distributed load of 3,000 lbs. per lin. ft. of track and a concentrated load of—I don't recollect how much—on the drivers, but an additional load, thus straining no part of the bridge in tension to more than 10,000 lbs. per sq. in. and under compression to a like amount, after making an allowance for bending strains; the bridge was built in conformity to the specifications read this morning; the maximum deflection obtained under all the tests, which were made with the two heaviest locomotives on the road, was about ⅝ in.; this truss received and supported three-fourths or four-fifths of the total load, the other truss taking either one-fourth or one-fifth. It is more bother to build a "skew" bridge and costs more; there is no more danger of breakage in a "skew" bridge than in a square bridge.

Nothing except the joint-blocks were of cast-iron; this one that is broken is to-day just as good for service as it ever was, and the break that is in it does not disable it at all. So far as I know, the Boston & Providence road had no officials to inspect the bridge at the time the test was made, but left it entirely to me. It wasn't inspected, so far as I know, by the railroad.

The two pairs of hangers from the Roslindale and Boston ends of the bridge were put in evidence. The pair of hangers at the Boston end of the west truss were broken in the lower loops. Both loops were badly rusted at the welds, and both snapped at the welds. These hangers were concealed by the casting in which they were suspended. A pair of hangers at the Roslindale end of the truss corresponding to the pair which broke, also showed cracks and rusting at the welds. The witness admitted that the loops were weaker by reason that the center of support were not under each other.

Mr. Crocker—Is that an old break in the hanger?—A. I could not say. When I examined it at the wreck on Monday it was enclosed in the casting, so that I couldn't tell; whether some of the rust that is now on it was there then I could not tell.

Mr. Crocker—Is that break due to a tension strain or a cross strain?—A. I think it was an enormous leverage of the floor-beam acting upon it when it went down with a crash.

Mr. Crocker—What does the break in the hanger evidence to your mind?—A. The leverage which it gets from the floor beam.

Mr. Crocker—Are those fresh breaks? A. I think so; I think they were caused by the fall.

Mr. Crocker—How soon did you see the hangers after the accident? A. I saw them Monday afternoon; they don't look as fresh now as they did then.

Do you think that (referring to the broken hanger, taken from the Boston side) was broken at the time of the accident? A. I think so.

Mr. Crocker—Were the hangers resting in the water when you saw them out at the wreck?—A. No sir.

Mr. Crocker—Was it raining at that time?—A. No sir not while I was there.

Mr. Crocker—Were they wet.—A. There was no moisture on them.

Mr. Crocker—Did they look differently then from what they do now? A. They looked slightly fresher than they do now.

Mr. Stevens—Did they look like good iron, in your opinion?—A. Yes, I think it is good iron, although it looks to me as though, when it was forged, it had been made too hot.

Mr. Kinsley—You built a bridge on the Boston & Maine didn't you?—A. Yes sir.

Mr. Kinsley—Is it standing now? A. No sir.

Mr. Kinsley—Where is it?—A. It was knocked down by a train that was off the track.

Mr. Kinsley—Where was it? A. I can't say; it was on the Boston & Maine extension.

Mr. Crocker—Do you state it as your opinion that neither of those two hangers were broken before the accident happened?—A. I should say so.

Mr. Putnam—Is there anything in the appearance of those hangers as you see them now, independently of the fact that they are broken, that would induce you to criticise the iron unfavorably?—A. No, sir.

Mr. Putnam—You consider it good iron so far as you can judge by appearance?—A. Yes, sir.

Mr. Putnam—How about the workmanship—do you see anything in the workmanship that would lead you to criticise those hangers?—A. There is one point where I think the iron was slightly overheated.

Mr. Putnam—And that is visible to inspection after the work is done, is it?—A. No, sir; only after it is broken.

Mr. Putnam—Is there anything which, if it were not broken, would induce you to criticise those hangers unfavorably if you were now inspecting them for acceptance?—A. No, sir.

Mr. Putnam—You are sure that the burning of the iron would not show except upon a break?—A. I should not know how to discover it.

Mr. Putnam—So far as you can judge from seeing the iron after it is broken, what is its quality in your judgment?—A. I think it is good.

Mr. Putnam—Do you see anything about it that would lead you to reject it?—A. I do not.

Mr. Putnam—Is there anything in the workmanship which you would criticise, except the burning of the iron which you find upon its being broken?—A. No.

There was much more of the testimony, chiefly devoted to theories of how the bridge might have fallen from some train accident. Mr Hewins is not a member in any grade of the American Society of Civil Engineers nor has he ever been an applicant. Neither is he a member of any local engineering organization, so far as we can learn.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The Committee on the form of rails and wheels have issued the following circular letter of inquiry to a few of the leading railroad companies:

The Committee of the American Society of Civil Engineers on the Form of Rails and Wheels will be greatly obliged if you will send them any extracts from your records of wheels removed which will shed any light on the following questions:

Proportion of wheels removed for sharp flanges.

Comparative MILEAGE AGE of wheels removed for sharp flanges and for other causes.

Comparative number of sharp flange wheels among steel-tired and cast wheels.

Effect of quality of cast wheels on the proportion of sharp flanges, or proportion of sharp flanges found among wheels of different makers.

Information may be sent to A. M. WELLINGTON, Secretary of the Committee, Tribune Building, New York.

The Committee is acting under the following resolution:

"*Whereas*, The relation which the form of the head of a rail should bear to the section of a car-wheel tread and flange has recently been in dispute, it being asserted, on the one hand, that they should have as long a line of contact as possible, and, on the other hand, that such long contact would be dangerous and injurious; and,

Whereas, The question raised by this diversity of view is of direct importance to many members of this Society, as well as to the public interest, and hence is one which this Society may appropriately consider through committee; therefore be it

Resolved, That a committee of five members of this Society be appointed by the President to consider and report to the Society on the proper relation to each other of the sections of rails and wheels; to what extent and at what points it is expedient that their sections should be such as to bring them normally in contact, and to what extent and at what points it is not expedient that they should be so in contact; and that the committee be instructed to seek information from all those who are known to have given the subject attention.

This resolution was submitted to letter ballot and adopted by a general vote of the Society. Subsequently, by vote at the Annual Meeting, the President was authorized to add two additional members to such Committee.

The Committee as now constituted, consists of the following members:

H. STANLEY GOODWIN, Gen. Sup. L. V. R. R., Bethlehem, Pa.

A. M. WELLINGTON, Editor ENGINEERING NEWS, Tribune Building, New York.

GEO. S. MORISON, 18 Exchange Place, New York.

SAMUEL REA, P. A. Engr. Penna. R. R., Philadelphia.

THOMAS RODD, P. A. Engr. Penna. Co., Pittsburg, Pa.

S. M. FELTON, Jr., Vice. Prest. N. Y. L. E. & W. R. R., New York.

JAMES ARCHBALD, Cons. Engr. D. L. & W. R. R., Scranton, Pa.

Engineers' Club of Philadelphia.—Record of regular meeting, March 19, 1887. President T. M. CLEEMANN in the chair; 32 members and 3 visitors present. The Secretary presented, for Mr. WILFORD LEWIS, the following note upon Phosphor-Bronze Wire for Helical Springs:

"About a year ago, in designing valves for hydraulic machinery, it became necessary to use springs in the water ways, and to guard against corrosion, it was suggested that they be made of phosphor-bronze. A piece of wire 12 in. diameter and several feet long was obtained from our fellow Member, Mr. LUDEES, for the special purpose mentioned, and coiled in the form of a spiral spring 1¼ in. diameter, from *c* to *c*, making fifty-

two coils. This spring was loaded gradually up to a tension of 30 pounds, but, as the load was removed, it became very evident that a permanent set had taken place. According to formulæ recommended by D. R. CLARK for helical steel springs, such a spring of steel should bear with safety a load of 20 pounds, while, according to the practice of the P. R. R., it might be used for double this load, or 40 pounds.

"A weight of 21 pounds was then suspended from the bronze spring, so as to allow a small amount of vibration, and the length measured from day to day. In 30 hours the spring lengthened from 20⅞ in. to 21⅝ in., and when suspended 200 hours, its length was found to be 21¼ in. It was concluded from this that 21 pounds was too great for durability, and that probably 10 pounds was as much as could be depended upon with safety. For a given load it was found that the extension of the bronze spring would be just double the extension of a single steel spring, that is, for the same extension, the steel spring is twice as strong.

"The above experiment is not very conclusive, but my practice now is to allow for phosphor-bronze springs the same extension or compression as for similar steel springs, and let them carry one-half as much load."

Mr. JOHN L. GILL, JR., presented the following paper on "Screw Thread."

"It was well know that a nut one-half the thickness of the bolt was stronger than the bolt, and that the bolt would break at its smallest diameter before the thread would strip. So I proposed to equalize more nearly the strength of the bolt and nut by cutting a more shallow thread—to take two-eights of the thread off at the top and fill up the groove two-eights. This reduced the thread to one-half the full size of the V instead of three-fourths, which is the proportion of the Franklin Institute thread. I had a number of bolts or rods made and tested, using an equal number with the V thread, the Institute thread and my new thread. My experiments were made on bolts one inch in diameter. By calculation I found the Institute thread gave 14 per cent. more area of cross section at the root of the thread than the V thread, and my plan increased the cross section about 15 per cent. over the Institute, or 30 per cent. over the V thread.

"The experiments with the testing machine confirmed the calculation. All the bolts broke in the thread, with a load almost in exact proportion to the quality of the iron and area of cross section at the weakest point. On cutting my new thread on a one inch bolt, the cross section is reduced 20 per cent., the Institute thread about 30 per cent., and the V thread nearly 40 per cent., of the original size in the four foot specimens used, two having the new thread stretched four inches,—one, three inches,—and one, two and three quarter inches,—in forty inches, before they broke.

"I found the elastic limit in only one of the Institute specimens and not at all in any of the V thread specimens.

"I am under the impression that car bolts and bridge rods, having the new threads, without upsetting, would be better than rods of the same size, with upset ends having large nuts on, and the Franklin Institute threads; for it is impossible to heat a rod in a smith fire without the risk of injuring the iron by overheating, and, in upsetting, the fibre of the iron is so distorted as to reduce the strength of the rod very materially.

"Besides, the holes made in the timber or iron through which the rods have to pass, do not have to be made any larger than the bolt, while in the size above referred to, the holes have to be increased 25 per cent., thereby greatly reducing the strength of the supported member. I am of the opinion that a different thread from that now in general use should be adopted for car and bridge building."

Mr. H. H. SINTZENICH, introduced by Mr. HENRY G. MORRIS, exhibited and described a Rail Chair which he had devised with a view of overcoming the objections to joints bolted through the webs of the rails, and of obviating the necessity for brace or check-blocks on curves. The lack of continuity and consequent wear of rail ends, and the constant loosening of nuts, were noted as the principal objections to present forms of rail unions. The invention consists of two pieces of cast-iron, one of which bears against one side of the web of the rail, and is held to the tie by three ⅝-inch coach screws, 6in. long, while the other piece abuts against the first and against the other side of the web of rail, forming a clutch which is held in place by a single screw located about 4 inches from the rail. Mr. SINTZENICH stated that these chairs have been used continuously, for two winters and one summer, on the Intercolonial Railway at Moncton, New Brunswick, that these screws had not once loosened, and that no other objection to the joint had been discovered.

The Secretary presented, for Mr. F. H. LEWIS, a paper upon the "Clapp-Griffiths Steel for Structural Work".

Mr. PERCIVAL ROBERTS, Jr., followed with some discussion of the paper, questioning that any advance in steel manufacture could be claimed for this process. The Secretary presented, for Mr. EMILE LOW, a paper upon "Maps for Railroad Surveys," wherein Mr. Low recommends the use of separate sheets, 19 in. x 24 in., which, on the scale of 200 ft. to 1 in., which he prefers, would each embrace about one mile of the road. He notes the convenience, as compared with large drawings, of handling and filling these sheets and carrying them in the field, for which latter use he shows a convenient portfolio, which answers, also, for a drawing board, and he gives the various systems of arrangement of contiguous sheets with reference to the meridian, convenience in tracing from two or more sheets, etc.

PUBLICATIONS RECEIVED.

Ninth Annual Report of the Board of Railroad Commissioners of the State of Iowa, for the year ending June 30, 1886. The report covers 7,564 miles, and shows net earnings of only $1,730 per mile of road. There are as yet only 267 railroad grade crossings in the State, or one for every 28.3 miles, largely because the railroad system is as yet imperfectly developed.

Levelling, and its General Application. By THOS. HOLLOWAY, London: E. & F. N. SPON, 1887. Size, 5⅛ × 8⅛ in. pp. 147. Price $2.00.

This is a book "written solely for the uninitiated" from an English standpoint. It is consequently very elementary, but as it treats of English instruments and practice only it is of little value to American engineers. The level is the Dumpy with its reversing properties, and the illustrations of rods upside-down, and reference to "boning-rods," chains and links, etc., while perhaps curious and interesting, add little to our own professional knowledge. The author quite properly apologizes for the rather crude nature of the majority of the illustrations.

CONSTRUCTION NEWS.

Water.

Cambridge.—City Engineer WM. S. BARBOUR has submitted his report for 1886. During the year 3,895.49 ft. of new streets were laid out and 2,404 miles of sewers built; there are now 73.834 miles of sewers.

Milford, N. H.—There is nothing definite decided on yet with regard to the water-works, but a system will probably be built by one of two firms within a year and a half. Some surveys were made a month ago by C. H. BARTLETT, and more surveying will be done as soon as the snow has disappeared.

Six-foot Wrought Iron Water Pipes.—The Government of New South Wales has accepted a contract to lay wrought-iron water pipe 6 ft. in diameter in connection with the Nepean water scheme; the line to be 5 miles long and the pipes to carry 50,000,000 gals. per day.

The Boston Meter Test.—The Water Board have adopted the following in connection with the proposed test of water meters:—

ORDERED, That the Water Board be requested in the proposed competition of water meters to subject the various water meters submitted to a service covering a period of 12 consecutive months, as follows:

Three months of that time to be a test upon high service of not less than 80 pounds pressure to the square inch.

Three months to be a test upon a service of not less than 40 pounds pressure to the square inch.

Three months to be a test upon a service of not less than 25 pounds pressure to the square inch, and a final test of three months' service in buildings connected to service pipes.

Otto Gas-Engines at the Water-Works at Coblenz, Germany.—These works, designed to supply about 1,000,000 gallons per day, take water from the Rhine by two wells. The water is pumped 194 ft. high into a 700,000 gallon reservoir by two Otto gas engines of 50 h. p. actual each; a third engine being held in reserve. The Otto engines are twin engines making 140 revolutions per minute, geared 5 to 28, so that the pumps make 25 double strokes per minute, and throw 550 gallons in same time. The gas is supplied by a 5-in. main, and the water pumped was expected to represent 80 per cent. of the horse-power of the engines. The water rate charged is 16 cts. per 1,000 gallons.

Waterbury, Conn.—The Board of Water Commissioners has submitted its report for 1886, being the twentieth annual report. During the year 7,968¼ ft., of main pipe were laid, and 4,333½ ft. taken up and discontinued, 22 gates and 13 hydrants have been set. The system now comprises 88.594¾ ft. of iron and 94,256¾ ft. of cement pipe; total, 182,851½ ft.; the size varies from 1-in. to 20-ins.; there are 271 gates, 3, 4, 6, 8, 12, 16, 18 and 20-in.; 224 hydrants, of which 188 are owned by the city, and 36 are private; and 123 meters of various sizes, this number includes 18 Worthington, 72 Union rotary, 3 Balls & Fitts piston, 28 Crown, 1 Hartford and 1 special. For the relaying of the water main to Beaver Pond brook, $37,500 was appropriated, and the contract for the pipe, 8,838 ft., was awarded in December to the Warren Foundry & Machine Co., of Phillipsburg, N. J., who were the lowest bidders; the pipe will be delivered and work commenced in the spring. New street reservoirs are recommended. Surveys have been made for an additional water supply, and a special report is to be made. NELSON J. WELTON is President, and JOHN FITZPATRICK, Secretary, to the Board.

Morristown, N. J.—Water-works are about to be established at Morristown, Burlington county, N. J. For particulars address Mr. WATKINS, office of the Superintendent, Camden & Amboy R. R., Camden, N. J.

Jesse W Starr, Jr.—This tolerably well known contractor has "adjusted" matters with his creditors at Belvidere, N. J., where he has an electric lighting contract. This is the same party who contracted to put in water-works at Joliet, Ills., and Wabash, Ind., but—

Montgomery, Ala.—The Capital City Water Co. has elected the following board: President, Capt. J. W. DIMMICK; Treasurer, A. H. HOWLAND, of Boston; Superintendent, W. F. ELLIS, Jr., of Colorado Springs; Directors, Hon. JOSIAH MORRIS, W. F. VANDIVER, W. F. JOSEPH, and DAVID WEIL, of Montgomery, and W. D. RICE, of Boston. The company is in a very prosperous condition.

Holden, Mo.—The J. B. Quigley Water-Works Co., of St. Louis, which has the contract for the water-works, will begin work shortly; Mr. ANDREWS, the company's engineer, has commenced the surveys. The large reservoir will be located a mile southwest of the city and will cover 22 acres of land; the stand-pipe in the city will have a capacity of 160,000 gals.; there will be five miles of mains and 50 fire plugs. The works will cost $75,000 and are to be completed by September.

Niagara Water Power.—A bill has been presented to the Ontario Legislature for the incorporation of the Niagara Tunnel & Water Power Co. by the corporation of the town of Niagara Falls, Ont., and several capitalists. A tunnel will be constructed from some point on the west bank of the Niagara river above the falls, or from the Chippewa river to some other point on the west bank of the Niagara river. Turbines will be used to transmit the power to factories, mills and for other purposes.

Irrigation in Colorado.—A bill is before the Colorado Legislature to prohibit canal or ditch companies from charging "royalty" for water from such canals or ditches; some of the companies demand a royalty, or bonus, of $10 or more per acre before allowing any right to take water, and then make an annual charge of $1.50 to $4 per acre in perpetuity. The bill has passed the lower house. Owing to the present rulings of the U. S. Land Department in regard to obtaining a title to the public lands, entries are not nearly as numerous as for several years past, and as a consequence there is not nearly the amount of irrigation to be done now.

New York & Hudson Valley Aqueduct Co.—A bill has been introduced into the State Assembly to incorporate this company for the purpose of establishing a series of reservoirs in the Adirondacks and building an aqueduct from there to Long Island, supplying Cohoes, Troy, Albany, Hudson, Poughkeepsie, Newburg, Yonkers, New York, Brooklyn and other places. The State to have the option of purchasing the works within 30 years. Capital stock, $60,000,000. ROWLAND R. HAZARD, IRA. K. PEEGGO, HOMER A. NELSON, and others, are interested. A similar bill was introduced last year but met with little encouragement.

The Quality of Croton Water.—Mr. A. A. Breneman, an analytical chemist of experience in such matters, in a late letter to the *Tribune* points out the fact that Croton water is not as pure as generally supposed, and in the proportion of putrescible organic matter contained is much below that of Brooklyn water. He says that, as a result of extended examination, the quality of Croton water in July, August and the first half of September is often such as to render it unfit for drinking; and in regard to the Bronx supply for the summer of 1886, the case might be cited much more strongly. Mr. Breneman very pointedly suggests that it is time to study the question of the quality of the Croton with something of the same energy that is now given to increasing its quantity.

Water Companies.—Suffolk County Water Co.; Patchogue, L. I.; FRANK G. LOCKWOOD, JOHN LOCKWOOD, of Brooklyn, and others; capital stock, $25,000.——National Water Supply Co.; Cincinnati, O.; will operate the Wagner steam well excavating process; President, P. J. SONG, Middletown, O.; Secretary, C. MORGAN, Middletown; Superintendent, JOHN A. WAGNER, Cincinnati, O.——Waukesha Water Works Co.; Waukesha, Wis.; IRA KIMBALL and others; capital stock, $200,000.——Arkansas Water Co.; Little Rock, Ark.; President, ZEB. WARD; capital stock, $25,000.——Towson Water Co.; Towson, Md.; President, J. PIPER.——Marion Water-Works Co.; Marion, O.; capital stock, $100,000.——Du Bois Water Co.; Du Bois, Pa.; Treasurer, L. A. BRADY.——Medicine Lodge Water Power Co.; Medicine Lodge, Kan.; J. W. MCNEAL and others; capital stock, $50,000.——Las Animas Water Co., Las Animas, Col.; FRANK P. ARBUCKLE and others; capital stock, $80,000.——Salisbury Water-Works Co.; Salisbury, N. C.; capital stock, $85,000.——A water company has been organized at Abilene, Tex., by J. H. PARAMORE, W. J. HUGHES and others.——At Harrisburg, Pa., charters have been issued for water companies for Sterrett, Braddock and Wilkinsburg; the in-

corporators are W. M. BRINKER, JAMES A. WILSON, ROBERT D. FRAZIER and A. W. DUFF.

New Water-Works.—Gallatin, Tenn. It is proposed to issue $40,000 in bonds for the establishment of a system of water-works.——Fernandina, Fla. The City Council has adopted specifications for water-works and has directed proposals to be advertised for; the issue of bonds will be voted on shortly.——Seattle, Wash. T. The Spring Hill Water Co. will resume work on its 4,000,000 gal. reservoir; the water will be pumped in from Lake Washington by two engines with a combined daily capacity of 2,500,000 gals.——Tarboro, N. C. The corporation council has decided to build water-works. ——Malden, Mass. A petition to take water from the Ipswich river and its tributaries and Martin's pond is before the Legislative Committee on Water Supply.——Loup City, Neb. A system of water-works is to be established at a cost of $15,000.——Creston, Ia. The ordinance has been passed granting a 25 years franchise to James Gamble, of New York; the city will rent 50 hydrants at $60 each per annum; the works are to be constructed at once.——Binghamton, N. Y. A large amount of pipe will be relaid.——Van Buren, Ark. A company has been organized to obtain a fire service supply from artesian wells.——Lockport, N. Y. The Council has not yet done anything with regard to the bids received for the new engine.——Pena, Tex. ENRIQUE VIZCAYA is drilling artesian wells on his ranch 25 miles south of the city.——Toronto, Canada. The Water Works Committee has not decided on adopting any of the plans for an increased water supply.——Pittsburg, Pa. A large amount of new pipe will be laid.——Minneapolis, Minn. The City Engineer is investigating the means of obtaining a larger supply from the West Side station. ——Brooklyn, N. Y. The bill for condemning land for the water-works has passed the State Senate.——Findlay, O. Water-works are to be established. Address Y. BICKHAM, Secretary, City Gas Works.—Greenville, Tex. A contract has been let for a system of water-works, to cost $75,000.

Hanover, N. H. Address H. C. SETTEE.——Perry, N. Y. Address R. H. STEADMAN.——Dixon, Cal. Address JOSEPH ENRIGHT.——Tilton, N. H. Address L. S. ATKINSON, Town Clerk.——Bessemer, Mich.——Housatonic, Mass.——Portage, Wis.——West St. Paul, Minn.——Navasota, Tex.——Ayer, Mass.——Colfax, Ia.——Georgetown, Tex.

Proposals Open.

Grading.—On the Chicago, Santa Fè & California R. R., between Galesburg, Ill., and the Mississippi river; in sections of one to ten miles. Profiles and specifications to be seen at Dallas, Ill., or Carrollton, Mo. PRICE & MCGAVOCK.

Water-Works.—Specifications have been adopted. THE CITY CLERK, Fernandina, Fla.

City Work.—Sewers and cedar block paving. WM. CARLYLE, Chairman, Committee on Works, Toronto, Canada, April 5.

Artesian Well.—Prices for rock, rotten rock and earth. JACKSON PIPER, M. D., Towson, Md. April 5.

Harbor Work.—Dredging in Duluth harbor, repairing canal piers and placing buoys. Capt. JAMES B. QUINN, U. S. Engineer Office, Duluth, Minn. April 7.

Repairing Bridge.—Over Gowanus canal at Third street. DEPARTMENT OF CITY WORKS, Municipal Building, Brooklyn, N. Y. April 7.

Penitentiary.—Separate bids for stone, brick and iron work. THE BOARD OF MANAGERS, Intermediate Penitentiary, Mansfield, O. April 14.

Buoys.—Buoys, chains and ballast balls. A. E. K. BONHAM, U. S. N., U. S. Light House Inspector (Third District), Tompkinsville, N. Y. April 14.

Sewer.—About 1,300 ft. and 1,900 ft. of 3-ft brick sewer; plans and specifications at Street Commissioner's office; estimated cost, $20,000. WM. ALLEN VEACH, City Clerk, Newark, O. April 15.

Building.—Keeper's dwelling and sinking a well at North Point, Milwaukee, Wis. Lieut. Col. S. M. MANSFIELD, U. S. Light House Engineer (Eleventh District), Detroit, Mich. April 16.

Court House.—Architects plans and specifications. Judge M. T. PORTER, Birmingham, Jefferson county, Ala. April 18.

Water Bonds.—Four per cent. bonds for $52,500. H. M. NEWTON, Secretary, Board of Water Commissioners, East Saginaw, Mich. April 19.

Harbor Work.—Rip-rap granite for the breakwater, and enlargement of the inner harbor at Block Island, R. I.; also for constructing jetties at Westport harbor, Mass. Lieut. Col. GEO. H. ELLIOT, U. S. Engineer Office, Newport, R. I. April 21.

Street Work.—Excavation, foundation, asphalt paving, granite curbing, etc. THOS. G. SMITH, President, Board of Public Affairs, Cincinnati, O. April 22.

Depot.—Union passenger depot; plans and specifications at company's office, and at office of Bradlee, Winslow & Wetherell, Boston. ARTHUR SEWALL, President, Portland Union Railway Station Co., 493 Commercial street, Portland, Me. April 23.

Contracting.

Pumping Machinery.—The contract for the pumping plant for the water-works at Elgin, Ill., has been awarded to Henry R. Worthington, New York City.

Drainage.—WM. M. WHITTEN, C. E., of South Bend, Ind., has a system of drainage comprising about 50 miles of open ditches to be let next month, draining an area of 20,000 acres.

The Cherokee Construction Co. has been organized at Chicago, Ill., to construct railroads, etc. The incorporators are Truman Penfield, Fred C. Stevens and Henry B. Merrick. Capital stock, $300,000.

Pipe Sewers.—Contracts for about ten or twelve miles of 6-in. to 24-in. pipe sewers for Cedar Rapids, Ia., will be ready to be awarded about April 25. Particulars will be given in our next issue.

The Brashear Parlor & Sleeping Car Co. has been incorporated at Baltimore, Md., to build cars on the patents of Wm. Brashear. Samuel W. Regester, S. Brashear, John Scott, and others, are interested. Capital stock, $2,000,000.

New Croton Aqueduct.—The proposals for shaft construction which were opened by the Aqueduct Commissioners, New York City, on March 30 (postponed from March 25), were all rejected and the work will be readvertised.

The New York & Southern Construction Co. has been organized at Richmond, Va., by J. P. PACE, JAMES T. GRAY, and others, with a capital stock of not less than $100,000 nor more than $250,000. The company purposes to build railroads, tunnels, docks, bridges, etc.

Breakwater.—The following bid for the construction of a breakwater at Agate bay, has been received by Capt. JAMES B. QUINN, U. S. Engineer Office, Duluth, Minn.: Christian Schwarz & Charles Berner, Green Bay, Wis.; $54.94¾ per running foot for foundation and crib work.

Stop Cocks, Hydrants, etc.—The following proposals were opened March 28 by the Commissioner of Public Works, New York City, for stop cocks, hydrants hydrant boxes and stop cock boxes.; G. C. Hotchkiss & Co., $14,370; J. Jonson, $17,130; John Fox, $18,929.50; C. Delamater (informal). The contract was awarded to G. C. Hotchkiss & Co.

Street Work.—At Cincinnati, O., proposals for improving Madisonville pike have been received from Harry McErlane, Hayes & O'Brien, Calvin H. Crane, and Delaney & Crowley. The City Engineer has submitted new specifications for asphalt paving on Seventh and Ninth streets; the gutters are to be laid with asphalt instead of granite, and there is to be granite paving between the street railroad tracks.

Dredging.—The following proposals were opened March 26, by Lieut. Col. D. C. HOUSTON, U. S. Engineer Office, New York City, for dredging in the Connecticut river: Frank Pidgeon Dredging Co., New York City, 11.7 cts. per cu. yd., $4,680; Hartford Dredging Co., Hartford, Conn., 12.3 cts. $4,920; John McDermott, Cohoes, N. Y., $13½; $5,450; Richard Parrott, Newburg, N. Y., 19 cts., $7,600.

Street Work.—The following proposals for Medina stone paving and street improvement have been received by JOHN A. SEYMOUR, City Engineer, Bradford, Pa.; O'Brien & Douglas, Bradford, $1,363.40; J & M. McMahon, Bradford, $1,656.75; W. Scott, Syracuse, N. Y., $1,689.65; P. B. McNaughton, Buffalo, N. Y., $2,192.90. The contract was awarded to O'Brien & Douglas,. The engineer's estimate was, $1,854.90, contingencies, $300, total, $2,154.90.

Stone Arch.—The following proposals have been received by J. D. HAWKS, Chief Engineer, Michigan Central R. R., for the construction of a three-center arch culvert on the Canada Southern Division:—Smyth, Leonard & Munford, St. Catharines, Ont., $7.45 per cu. yd.; W. M. Hendershot, Thorold, Ont., $7.45; John Esson, Toronto, $7.50; Jas. Barry, Niagara Falls, and Jas. Smeaton, Queenstown, Ont., $7.85; Jas. A. McMahon, St. Catharines, $8.35; Esson & Holt, Toronto, $9. The contract was awarded to John Esson, at $7.50, as this bid included part of the centering.

The National Association of Builders held its convention at Chicago this week. The object was chiefly to deal with the labor question; the builders desire to pay per hour at a price to be fixed upon between the employer and individual workmen, they also desire a clause in contracts relieving contractors from responsibility for delay caused by strikes. President, J. MILTON BLAIR, Cincinnati, O.; First Vice President, JOHN S. STEVENS, Philadelphia, Pa.; Second Vice President, EDWARD E. SCRIBNER, St. Paul, Minn.; Treasurer, J. J. TUCKER, New York City; Secretary, WM. H. SAYWARD, Boston. A resolution in favor of a uniform system of specifications and contracts was referred.

The Chalmers-Spence Co., New York, miners and shippers of asbestos, and manufacturers of boiler and pipe coverings, millboard, packing and specialties, have found it necessary to lease the building adjoining their present works, which will double their floor space and capacity. Asbestos, owing to its incombustible nature, lightness and adaptability to various manufactures, has of late become of great commercial importance. The Chalmers-Spence Co. was the pioneer in its introduction and is at the present time the owner of the largest asbestos mines in the world.

Pipe Laying.—At Rochester, N. Y., the Executive Board has awarded contracts to Geo. Chambers as follows; trenching and pipe laying; excavating and filling, 25 cts.; laying 4, 6 and 8 in. pipe, 14, 11, 10 cts.; total, $981.20. Pipe crossing at canal; trenching, 35 cts. per ft.; laying 10-in. and 8-in. pipe, 20 cts. and 50 cts.; canal crossing, $2.85 per ft., total, $379.25. Pipe crossing at canal; trenching 35 cts.; laying 10-in. and 4-in. pipe, 20 and 12 cts.; canal crossing, $4.17 per ft.; total, $754.55. Pipe crossing at canal; trenching, 35 cts.; laying 10-in. and 6-in. pipe, 20 and 12 cts., canal crossing, $3.53; total $295.65. The award of another contract for trenching and pipe laying was deferred. The other bidders were Thos. Oliver & Son, John Howe, Wm. Fuller and David Clancy.

Bridge.—The following proposals for an iron Pratt truss bridge over the Patapsco river at Ilchester, Md., have been received by WM. H. SHIPLEY, Superintendent of Bridges for Baltimore county, Baltimore, Md.: Pittsburg Bridge Co., Pittsburg, Pa., eight panels, $3,193; nine panels, $3,330; ten panels, $3,394. Groton Bridge Co., Groton, N. Y., nine panels, $3,400. Dean & Westbrook, New York City, nine panels, $3,500. Penn Bridge Co., Beaver Falls, Pa., nine panels, $3,575. Smith Bridge Co., Toledo, O., nine panels, $3,640. King Iron Bridge & Manufacturing Co., Cleveland, O., $3,690. Wrought-Iron Bridge Co., Canton, O., $3,945. H. A. Ramsey & Son, Baltimore, Md., $4,284.

Water-Works.—Proposals for a complete system of water-works on the rental plan have been received by A. L. HOWE, Chairman Committee on Water-Works, Natchez, Miss., from S. R. Bullock & Co., New York City; Inman Bros., New York City; A. J. Kennedy & Co., New Orleans, La., and W. W. Taylor, Philadelphia, Pa.; the bids were all the same, $60 per hydrant for 80 hydrants; total, $4,800. The contract was awarded to S. R. Bullock & Co., their bid being cheaper on extensions ($45 per hydrant for all above 80) and also cheaper on water for private consumption. The works are to be finished within one year.

Bridges.—The following proposals were opened March 16, by the County Commissioners at Ness City, Kan., for two 60 ft. bridges with approaches and iron trestle piers; Missouri Valley Bridge Co., Leavenworth, Kan., $3,570, $3,950. Mount Vernon Bridge Co., Mount Vernon, O., $3,728, $3,895. Wrought-Iron Bridge Co., Canton, O., $3,790, $3,999. Kansas City Bridge Co., Kansas City, Mo., $3,987.85, $3,968. Columbia Bridge Co., Dayton, O., $3,995, Arkansas Valley Bridge Co., Newton, Kan., $3,995. P. E. Lane, Chicago, $3,999. Bullen Bridge Co., Leavenworth, Kan., $4,000. The contract was awarded to the Mount Vernon Bridge Co., at $3,728 for a truss bridge, dead load 450 pounds and live load 1,600 pounds per lineal ft. S. B. MERRILL, C. E., is Bridge Commissioner.

Pumping Engine and Boilers.—The following proposals were opened March 28, by the Board of Water Commissioners, Norfolk, Va., for a pumping engine, of 2,000,000 gals. daily capacity and two steel boilers: Engine; Henry R. Worthington, New York, $2,030 and $3,065. Holly Manufacturing Co., Lockport, N. Y., $2,400 and $3,100. Deane Steam Pump Co., Holyoke, Mass., $2,835. Volker & Felthousen Manufacturing Co., Buffalo, N. Y., $3,100. Blake Manufacturing Co., New York, $3,150. Knowles Pump Co. (by Goodwyn, Norfolk, Va.), $3,300. Atlanta Wind Engine Co., Atlanta, Ga., $3,360. F. W. Goodwyn & Co., Norfolk, Va., $4,500. Davidson Steam Pump Co., New York, $5,450. The contract for the pump was awarded to the Deane Steam Pump Co., of Holyoke, Mass. The contract for the boilers was not awarded, the Board being unable to agree, and action was deferred.

Water-Works Supplies.—The following proposals have been received by the Water Board, Boston, Mass.: Brass castings and composite castings: Wm. Curley, East Boston, 13¾ cts. and 15¾ cts. per pound; Mowry & Phillips, Boston, 14¾ cts. and 16¼ cts.; Stephen Anderson, Boston, 14¾ cts. and 16¾ cts.; Crosby Steam Gauge & Valve Co., Boston, 15 cts. and 17 cts.; Whittier Machine Co., 16 cts. and 18 cts.; Portsmouth Machine Co., Portsmouth, 16 cts. and 18 cts.; P. P. Emory & Co., Springfield, 12 cts. and 20 cts.——Iron castings and service box castings: Samuel B. Lock & Co., Boston, 2.15 cts. and 2.25 cts. per pound; Osgood & Hart, Boston, 2.25 cts. and 2.25 cts.; Builders Iron Foundry, Providence, 2.25 cts. and 3.5 cts.; Chelmsford Foundry Co., 2¾ cts. and 2.5 cts.; Whittier Machine Co., Boston, 2.75 cts. and 3.5 cts.; Portsmouth, Machine Co., Portsmouth, 2.99 cts. and 2.59 cts.

Bridge Contracts.—The Atlanta Bridge & Axle Co. of Atlanta, Ga., has been awarded the contract for the Oostanaula river bridge for the Rome Land Co. The contract price is $15,000, and the bridge is to be completed by August.——Hubaner Bros. & Sickles, of Jacksonville, Fla., have been awarded a bridge contract for $2,995.——Engelbert Schmicker has the contract for a stone bridge of two arches over the Little Mahanoy creek at Ashland, Pa., for $3,500.——Keller & Goll, of Lancaster, Pa., have the contract for removing the big Conestoga bridge and building a stone bridge in its place for the Pennsylvania R. R.; the new bridge will have five spans of 54 ft. each.

The American Chain Cable Works are located at Troy, N. Y. They were established by Gen. Jos. B. Carr, about 1865, and with him were originally associated Judge N. J. Rockwell, Hon. Wm. Kemp and D. W. Tuthill; of these only Messrs. Carr and Kemp remain in the business. The works are extensive and the reputation of their product is well established both at home and abroad. The iron used is rolled expressly for them by the Burden Iron Co. and the Troy Iron & Steel Co., and is the best made for chain purposes. The company makes a special feature of chains for dredges and cranes, the product being hard and at the same time tough and fibrous; about two-thirds of their whole force is constantly employed in turning out chain of this character. They test all chains and give a certificate of proof with each, and guarantee the iron in their B. B. B. chains to stand a strain of 70,000 lbs. per sq. in. Their works are now run to their fullest capacity in filling orders on hand and more are constantly coming.

Dam.—The following proposals for the construction of a dam on Gilbert brook have been received by JOHN A. SEYMOUR, City Engineer, Bradford, Pa. S. S. King, Bradford, $7,583.50; J. & M. McMahon, Bradford, $7,636; J. C. McCrea & Co., Bradford, $7,733; J. A. Waldo & A. W. Sweitzer, Bradford $7,864: A. J. Edgett, Bradford, $7,909; Sheehan, McDonald & Moarn, Bradford, $8,368; Eugene Peake, Elmira, N. Y., $8,420; R. H. Wilcox, Bradford, $8,792.50; Thomas Hayden, New York City, $9,769; P. B. McNaughton, Buffalo, N. Y., $10,267.75; T. A. Madden & J Jacoby, Bridgeport, Conn., $11,940. The contract was awarded to J. & M. McMahon at the following prices: grubbing and clearing, $135 per acre; earth excavation, 35 cts. per cu. yd.; puddling excavation, extra, 10 cts.; cement masonry, $6 per cu. yd.; rip rap wall, $1 per cu. yd.; timber, $20 per M.; 12-in. pipe, $1.50 per ft.; Ludlow valves, $55 each; oak rack, $25; wire screen, $12; covering to inlet chamber, $15; road building, $3 per rod. The engineer's estimate was $8,519, contingencies, $500, total, $9,019.

Cable Railroads.—At Kansas City, Mo., Chief Engineer KNIGHT has awarded the contracts for the construction of the Twelfth Street cable line. The contract for the street construction was awarded in two sections of $125,000 each, to Bernard Corrigan, of Kansas City, and Taylor, Bennett & Co., of St. Louis; this work includes the excavation, conduit and paving. The contract for the viaduct over the railroad tracks in West Kansas was awarded to the Phœnix Bridge Co., of Phœnixville, Pa., for $40,000; the structure will be a quarter of a mile long. The contract for the superstructure of the bridge over the Kaw river was awarded to the Kansas City Bridge & Iron Co. for $35,000; the piers are being built and will be ready by May. Work on the line is to be commenced at once and completed by September. The line will be double track, 10,000 ft. long, to be built as follows: April, 1,000 ft.; May and June, 2,000 ft. each; July and August, 2,500 ft. each. The contract for the Wyandotte street line was awarded to William H. Faulkner for $110,000.

At St. Paul, Minn., the contract for the construction of the Selby avenue cable line has been awarded by Gen. T. P. WILSON to the New York Cable Railway & Construction Co., of New York, of which Col. Z. P. BOYER is General Manager. The cars will be built at the Pullman works.

Railroad Contracts.—Mr. Johnson, of Omaha, Neb., has a contract from the Chicago & Northwestern R. R. Co., for grading the Fremont, Elkhorn & Missouri Valley line from Arlington, ten miles north of Fremont, to Omaha.

The Kentucky Paving & Contract Co., of Louisville, Ky., has the contract for the construction of the Hodgenville & Elizabethtown R. R., and has sublet contracts for grading.

N. S. Young, of Ancona, Ill., has contracts for grading on the Chicago, Santa Fé & California R. R. in Livingston and Marshall counties, Ill.; and on the second track of the Chicago, Burlington & Quincy R. R. from New London to Mt. Pleasant, Ia. He is advertising for teams and sub-contractors.

Broadhead & Hickey, of Flemington, N. J., have been awarded the contract for the construction of the Wilkes Barre & Scranton branch of the Lehigh Coal & Navigation Co.'s railroad. Chief Engineer WHITNEY'S estimate was $400,000. The road will be in operation by June.

Mason, Foard & Co., of Louisville, Ky., have the contract for grading the Louisville, St. Louis & Texas R. R. between West Point and Stephensport, Ky. Contracts for the other sections will not be let yet.

The Arkansas Midland R. R. Co. has awarded contracts for changing its road to standard gauge and for standard gauge rolling stock. The gauge will be changed in June.

The Goodwin Dump Car.—Aug. Mordecai, Engineer-in-Charge of Way, Mahoning Division, New York, Pennsylvania & Ohio R. R., has lately reported to the superintendent on tests of the Goodwin Dump Car, in brief, as follows: The car is a four-wheeler, 8 ft. 10 in. wide by 20 ft. 10 in. long over all, and 3 ft. deep in center; weight of car, 12,000 lbs. The inclined floors have a pitch of 6½ in. in 1 ft. The several parts of the dumping-gear are reported as strong and simple and not liable to get out of order; recent improvements have simplified the apparatus for replacing the doors, which is now entirely beneath these doors and does away with chains, rod, etc. The bulk capacity of the car, for coal, slag, etc., is 9 cu. yds. The center of gravity, according to the load, is from 6 ft. 6 in. to 6 ft. 8 in. above the rail. With a rack 2 ft. high the car will carry 10 tons of coke. This car will dump either the whole load on either side of the track or the half on each side; or by a simple arrangement dump the load between the rails; it will also dump coke effectually, a thing usually difficult. Mr. Mordecai reports the handling as easy and prompt, and the load dumped as not interfering with the rails. The car experimented with was built early in 1883, and had an actual tonnage service of 4,760$\frac{75}{100}$ ton-miles, or something over the average performance of 8-wheel gondolas in the same trade; the additional round test trip made this service 6,613 ton-miles, or 36 per cent. above the performance of 8-wheel gondolas. The report gives the test in detail as to mileage, character of load, conditions of loading and unloading, etc., and concludes by saying it is "a good dump-car" and is well adapted to handling furnace-slag for ballast, for which purpose the test seems to have been ordered.

Street Work & Sewers.—The following proposals were opened March 28 by the Commissioner of Public Works, New York City: Curbing and flagging on 62nd street; M. J. Kane, curbing, 70 cts per lin. ft.; flagging, 25 cts. per sq. ft., total, $1,289. Geo. F. Masterson, 73 cts., 27 cts., $1,372.80. P. McInerny, 64 cts., 26 cts., (informal) The contract was awarded to M. J. Kane.——Flagging sidewalks on 17th street; Geo. F. Masterson, $1,843.20; he was awarded the contract.

Sewer on Attorney street; C. Smith, $1,922.35; Geo. F. Masterson, $1,938; P. Kearns, $2,314 25. Contract awarded to Cornelius Smith.——On Avenue B; C. Smith $2,149; J. J. Montgomery, $2,224.75; Thos. Cunningham, $2,319.75; P. Kearns, $2,760.25; Jos. Moore, $3,010. Contract awarded to C. Smith.——On Fourth avenue: Jos. Moore, sewer $6 per ft.; 12-in pipe culvert, $2 per ft.; receiving basins $100; rock excavation, $5 per cu. yd.; timber, $1 per M. total, $12,391: M. J. Kane, $6, $1.50, $175, $5, $10, $12,535; Geo. F. Masterson, $5.35, $1.35, $195, $3.95, $35, $10,493.50. F. A. Smith, $5, 25 cts., $150, $4.50, $20, $10,952.50. Contract awarded to Geo. F. Masterson.——On 64th street; M. J. Kane, $4,447.75; P. Kearns, $4,554.75; F. A. Smith, $5,006.50; Jos. Moore, $5,645; Geo. F. Masterson, (informal). Contract awarded to M. J. Kane.——On 102nd street; P. Kearns, $2,690; J. J. Montgomery, $2,642: Jos. Moore, $2,781; Jas. Slattery, $2,804; Geo. F. Masterson, (informal). Contract awarded to P. Kearns.——On 103rd street; P. Kearns, $2,590; J. J. Montgomery, $3,111.80; John Slattery, $3,204; Jos. Moore, $3,281; Geo. F. Masterson, $3,317. Contract awarded to P. Kearns.

Water-Works.—At Salem, O., the following proposals have been received for the construction of a water-works system: Turner, Clark & Rawson, Boston, Mass.; supply from springs; collecting reservoir with two compartments of 500,000 and 100,000 gals. capacity, the smaller to be reserved for fire service; two independent 10-in. mains with smaller distribution pipes; stand-pipe or reservoir with a capacity of 300,000 gals.; two Blake pumping engines with combined daily capacity of 3,000,000 gals.; hydrants and fittings; the town to pay $4,000 per annum for 20 years, with option of purchasing works; the works to be completed within a year from the date of contract.

S. B. Bullock & Co., New York City; supply, engines, etc., as above; stand-pipe not less than 22 ft. diameter and 140 ft. high; not less than 10 miles of pipe, from 6 to 14 ins. diameter; 110 hydrants, extra hydrants $20 each; water free for sewers, fountains, city offices and fire purposes; the town to pay $3,300 per annum for 25 years, with option of purchase after five years.——American Water-Works & Guarantee Co., McKeesport, Pa.; capacity of works, engines, etc., as above; not less than 10½ miles of pipe; 120 hydrants; extra hydrants $25 each, not less than 12 to the mile; free supply as above; the town to pay $3,334 for 20 years, with option of purchase after ten years; local labor to be employed; works to be completed in ten months.——J. H. Harlow & Co., Pittsburg, Pa.; supply from springs; wrought-iron tank 30 ft. diameter, 30 ft. high, capacity 150,000 gals., on brick tower 80 ft. high; two compound duplex pumping engines, 1,000,000 gals. daily capacity; 5,300 ft. of 12-in cast-iron pumping main, 8,300 ft of 10-in. pipe, 5,600 ft. of 8-in., 35,000 ft. of 6-in., 2,000 ft. of 4-in.; 120 hydrants; the town to pay $91,000, 10 per cent. to be retained for one year after completion: alternative, $88,000 paid as work progresses; the company agrees to operate the works, bearing all necessary expenses, for three years, at $200 per month; work to be completed in eight months from date of contract.——Bassett Bros., Buffalo, N. Y., made a bid but it was not reported on by the committee.

The Water-Works Committee unanimously recommended the acceptance of the proposal of Turner, Clark & Rawson, for 15 miles, with certain modifications to be made in the ordinance. The subject will be put to the vote on April 4.

Railroads, Bridges and Canals.

Franklin & Megantic R. R.—Snow has caused considerable interference to traffic on this 24-in. gauge road in Maine. Kingfield, the terminus of the line, had but six regular mails in one month.

Minnesota & Northwestern R. R.—Work is in progress on the tunnel near Galena, Ill., on the line between Galena and Dubuque. It is in solid rock and will be 2,450 ft. long. It is to be completed by November.

Santo Domingo Central R. R. Co.—This company, organized chiefly by New York parties, and having a capital of $500,000, has obtained from the Government of Santo Domingo (Hayti) a concession for a railroad on the island.

A New Railroad for Venezuela.—The Government of Venezuela has authorized the construction of a railroad from Caracas to Antimano; the expenses to be paid out of the national treasury and the work to be done under the control of the Junta de Fomento of Antimano.

San Antonio & Aransas Pass R. R.—The engineer corps under Capt. P. G. BRENNAN has reached Houston, finishing the preliminary survey from Eagle Lake; the line will be located at once. Track laying is in progress between Cuero and Hallettsville and will be continued through Wharton, Austin and Harris counties to Houston, Tex.

Dry Docks.—The Secretary of the Navy has appointed Rear Admiral JOHN LEE DAVIS, Commodore W. H. MCCANN and Captain F. RAMSEY, as a committee to locate the sites of the two new dry docks for which the last Congress made an appropriation of $1,100,000. It is expected that one will be located at New York, and one at Norfolk, Va.

Cheyenne & Northern R. R.—The road has been completed for a distance of 75 miles, and is being operated; the company has received three fifths of the $400,000 in bonds voted by Laramie county. The road is located and mostly graded for about 50 miles farther, to the North Platte river, near the mouth of Cottonwood creek, leading toward the new town of Douglas, on the Fremont, Elkhorn & Missouri Valley R. R. (Chicago & Northwestern R. R.).

Central Ontario R. R.—This company, controling large iron interests, will form part of a combination that has been organized to purchase and control all the iron deposits of Canada. The road will be extended 150 miles through the iron districts to a junction with the Canadian Pacific R. R. at Lake Nipissing. ERASTUS WIMAN is reported to be interested in the scheme.

Canals in Florida.—The Banana & Indian River Inlet Co. has been organized at Jacksonville, Fla., to construct a canal from these rivers at Merritt's island to the ocean.——A company has been organized to construct a canal to connect lakes Ola, Carleton and Beauclair, which latter has a natural outlet to lake Dora. LEWIS MABOT, JAMES SINCLAIR, and others, of Tangerine, Fla., are interested. The capital stock is $4,000. A lock will be required.

A Subway Crossing.—At Toronto, Ont., the Parkdale authorities and the special committee of the Council have been in conference over the question of a subway at the dangerous crossing on King street west. The engineer submitted a plan, the estimated cost of which was $125,000. The total cost, interest and sinking fund, calculated at 4¾ per cent. per annum for 40 years, would amount to about $6,000 per annum, of which the railroad companies would pay $3,000. The matter will be further discussed before anything definite is done.

An Elevator on the Elevated Railway.—A syndicate of enterprising owners of real-estate in the neighborhood of the 116th street station of the New York elevated railway, are about to erect a building with an elevator. The road at this point over-tops six-story tenements, and crawling up and down stairs is an objection that interferes with the sale and rental of property in the neighborhood; hence the elevator. The total estimated cost of building and machinery is $50,000, and it will cost about $500 per month to run it.

The Prince Edward Island Tunnel.—At Ottawa a committee of the Cabinet has been appointed to thoroughly investigate the tunnel project and to make a report as to whether a subsidy should be granted.

A Great Railroad Scheme.—The New York Underground R. R. Co. has projected a great scheme for increasing the freight facilities of the city. The principal features are a large union terminus in Morrisania, a cantilever bridge over the Hudson at Washington Heights to connect with all the railroads on the New Jersey side, and an elevated freight railroad along the water front of New York City, with sidings to warehouses, etc. The underground railroad itself will be for passenger traffic alone, and will use the present tracks from 42nd street to the new depot, as the Grand Central Depot will be abandoned.

A Wyoming Narrow-Gauge Railroad.—A narrow-gauge railroad is projected from Laramie City, on the Union Pacific R. R., southeasterly to Fort Collins, Loveland and Longmont, Col., making connection at the latter point with the Denver, Utah & Pacific R. R., an existing narrow-gauge line. This will give a new and direct line from Laramie City, Wyo., to Denver, Col., which will compete with the Colorado Central R. R. (a Union Pacific line) between Denver and the above named towns. It will also give a new outlet for the stone quarries and the gold, silver and copper mining districts being opened up along the Foot Hills, southwest from near Fort Collins.

The Chattancoga Land, Coal, Iron & Railroad Co. has been incorporated at Chattanooga, Tenn., with a capital stock of $12,000,000. The company owns a large property of 22,000 acres near the city, containing coal, iron ore and timber; two bridges will be erected across the Tennessee river, on which the company has a frontage of ten miles, and two blast furnaces; a railroad will be built through the property up Walden's ridge to the coal fields, and also a belt line round the property, connecting with the Cincinnati Southern R. R. where it crosses the Tennessee river. The Chattanooga Western R. R. will form part of the system. J. W. ADAMS is President, and H. CLAY ADAMS, Secretary.

Omaha & Council Bluffs Bridge.—The Omaha & Council Bluffs Railroad & Bridge Co. has been incorporated at Omaha, Neb., with a capital stock of $600,000; authorized capital, $1,000,000. The directors are JOHN T. STEWART, GEO. F. WRIGHT and T. J. EVANS, of Council Bluffs, Ia., and F. MURPHY, GUY C. BARTON and J. H. MILLARD, of Omaha. It will be a highway bridge with a street railway which will be operated by electricity or steam motors; the roadway will be 24 ft. wide, and the sidewalk 6 ft. wide. On the west side there will be 1,200 ft. of viaduct; the river will be crossed by three truss spans, 50 ft. above the water; plan "A" is for one span of 400 ft., and two of 250 ft. each; plan "B" is for three spans of 300 ft. each. The piers will be wrought-iron cylinders filled with concrete. The calculation of strains is based upon a Baldwin enclosed noiseless locomotive weighing 35,000 lbs. on a wheel-base of 6 ft., followed by a train load of 1,000 lbs. per ft., and Jan Aveling & Porter steam road roller placed on the roadway. The bridge will be built of iron or steel, with cedar block paving. Printed specifications have been issued to several large bridge firms and proposals are being received.

Bridges.—At Rochester, N. Y., a bridge is to be built across the Genesee river by the supervisors.——At Frederica, Del., it is proposed to remove the drawbridge over the creek and build a permanent bridge.——At Pittsburg, Pa., a bridge is to be built over the Monongahela river at Twentieth street; PATRICK FOLEY and EDWARD KENNEDY are interested.——At Eagle Pass, Tex., a new bridge is to be erected; Dr. ORNELAS is interested.——At Fort Hunter, N. Y., a bridge is to be built across Schoharie creek.——The commissioners of Jefferson county, Pa., will build a bridge of 150 ft. span at Brockwayville.——At Dubuque, Ia., surveys for another bridge are being made by the Chicago, Burlington & Northern R. R.——At Cohoes, N. Y., a bridge will be built over the Champlain canal at a cost of $6,000; address J. T. GORMAN.——The Storm King Bridge has been favorably reported in the New York State Assembly.——The commissioners of Snyder county, Pa., will build a bridge near Middleburg.——At Savannah, Ga., the South Carolina R. R. Co. will build a new bridge over the Savannah river.——A suit has been entered for an injunction to prevent the building of the Arthur Kill bridge, as it would prevent the petitioner's canal boats from reaching the Raritan river.——At Council Bluffs, Ia., the Union Pacific R. R. bridge to Omaha, is being completed; it will have a double-track cable line.——At St. Paul, Minn., the plans for the Forbes street bridge are being prepared by City Engineer Rundlett; the entire cost is expected to be within the $500,000.——The Commissioners of Tioga county, Pa., will build an iron bridge at Wellsboro.——Thirteen spans of the wagon bridge across the Platte river, south of Columbus, Neb., were washed out by the flood on March 13.

THIS ROOFING is the perfected form of portable Roofing, manufactured by us for the past twenty-seven years, and is now in use upon roofs of Factories, Foundries, Warehouses, Cotton Gins, Chemical Works, Railroad Bridges, Cars, Steamboat Decks, etc., in all parts of the world.

It is supplied ready for use in rolls containing 200 square feet, and weighs with Asbestos Roof Coatings to finish, only about 85 pounds to 100 square feet.

It is adapted for all climates and can be readily applied by unskilled workmen. Samples and Descriptive Price List free by mail.

H. W. JOHNS MANUFACTURING COMPANY,
SOLE MANUFACTURERS OF
H. W. Johns' Asbestos Fire and Water Proof Sheathing, Building Felt, Steam Packings, Boiler Coverings, Liquid Paints, Roof Paints, Roof Cement, Fire Proof Paints, etc.
175 RANDOLPH ST., CHICAGO, ILL.
NEW YORK. PHILADELPHIA LONDON

IN PREPARATION. **READY APRIL 1st**

Poor's Directory of Railway Officials

FOR 1887.

A SUPPLEMENT TO POOR'S MANUAL OF RAILROADS.

Cloth, 400 Pages, Royal Octavo. **Price, $2.00 per Copy.**

CONTAINING LISTS OF

Officers of all Steam Railroad Companies in the United States and Canada: Officers of all Street Railroad Companies in the United States and Canada: Officers of New Railroads now in process of construction, with data respecting Location of Lines, etc., etc.: Officers of Auxiliary Enterprises—Bridge and Union Depot Companies, Fast Freight Lines, Express, Sleeping-Car, and Equipment Companies, etc., etc.: Officers of Industrial Enterprises Dependent on the Railway System—Car-Axle Manufacturers, Car Builders, Car-Wheel Manufacturers, Car-Spring Manufacturers, Rail Mills, Locomotive Builders, Bridge Builders, Contractors, etc., etc.: Officers of Associations of Railroad Officials and of Railroad Employees, Pools, Commissions, Boards of Railroad Commissioners, etc., etc.

TO THIS IS ADDED

An Alphabetical Index to the Names of all the Officials above mentioned, with a convenient system of reference, showing Lines with which each is connected: and

An Alphabetical Index of Cities and Towns, by means of which can be ascertained the Names of all Officials in any particular city or town at once.

FOREIGN RAILROADS.

In addition to the information given respecting the Railroads of the United States and Canada, the very excellent list of Railroads in Mexico, West Indies, Central America, South America, and Hawaiian Islands, given in last number of this work, and which proved such an acceptable feature of the book, will be very much improved and elaborated.

COMMENTS OF THE PRESS:

"The least that can be said of this volume is that it is as accurate as it is comprehensive it is far ahead of any publication of the kind which has yet been attempted, and will be an extremely useful work of reference."—*Railroad Gazette.*——"Brings within convenient compass most of the information required regarding railway officials. * * * The value of the book is so self-evident that a further review seems unnecessary."—*Railway News.*——"In its way, fully as valuable as the MANUAL."—*Boston Commercial Bulletin.*——"Of great value to the commercial industries of the country."—*London* (Eng.) *Bullionist.*——"Useful to those dealing with railroad companies."—*American Machinist.*——"Will undoubtedly prove of much value and service to many."—*Iron Age.*——"This immense compilation will be useful as a mailing guide. That there is a demand for it is evidenced by its publication; the Poors have a keen scent for success and know how to make it. The list of railways in Mexico, Central and South America, which concludes this volume is the neatest and most compact statement of the subject we have seen."—*New Orleans Picayune.*

COMMENTS OF RAILROAD OFFICIALS:

Office of PURCHASING COMMITTEE, WABASH, ST. LOUIS AND PACIFIC RAILWAY, 195 Broadway.
New York, October 5, 1886.

Messrs. H. V. & H. W. POOR, 70 Wall Street, City.

Gentlemen:—I have received a copy of your Directory and find it to be a very complete and useful work of the kind. The indexes to officials and advertisements are particularly convenient, and when extended as you propose in the coming year will make the volume a practical business directory. Purchasing agents and others having these matters to classify will appreciate the great utility of the arrangement.

The book ought to be a success.

Yours truly,
(Signed) O. D. ASHLEY, *Secretary,*
Wabash, St. Louis and Pacific Railway Co.

Office of the GENERAL PASSENGER AGENT, NEW YORK, LAKE ERIE AND WESTERN RAILROAD CO.
New York, September 24, 1886.

Messrs. H. V. & H. W. POOR, Publishers of Poor's Directory, etc., 70 Wall Street, City.

Dear Sirs:—I am in receipt of copy of your Directory of Railway Officials and Railway Directors for 1886 and have examined the same and find it very complete. I am especially pleased with your classified Directory of Advertisements, by which parties desiring any kind of railroad supplies can turn to this index and immediately ascertain the names of parties advertising the kind of supplies they desire to obtain. Yours truly,

(Signed) JNO. N. ABBOTT, *General Passenger Agent.*

Advertising rates and all other information will be furnished on application to
POOR'S MANUAL OF RAILROADS,
70 Wall Street, New York.

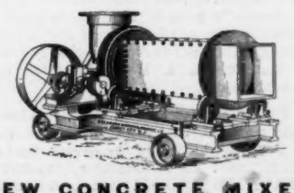
Notice to Contractors.

SEALED PROPOSALS will be received by the undersigned up to 12 o'clock M., of the 25th day of April, 1887, for the excavation of the Birk and Grisi ditches from station 140 to station 400 and from station 120 to station 254. Said ditches are from 17 to 36 ft. wide and from 3 to 8 ft. deep. Estimated earth work, 136,000 yds. Particulars furnished on application to

WM. M. WHITTEN,
Com'r of Drainage,
14-3t 125 N. Lafayette St., South Bend, Ind.

The Cockburn Barrow & Machine Co.

MANUFACTURERS OF



NEW CONCRETE MIXER.
234 to 240 Eleventh St., Jersey City, N. J.